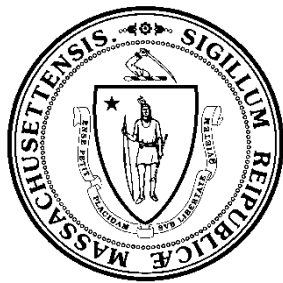


Massachusetts 2017 Air Quality Report



Department of Environmental Protection
Bureau of Air and Waste
Division of Air and Climate Programs

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The photo on the cover is a view of the air monitoring station on Holden St. in North Adams.

This report is available on MassDEP's web site at

www.mass.gov/eea/agencies/massdep/air/quality/air-monitoring-reports-and-studies.html

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List of Abbreviations

| | |
|-------------------------|---|
| AAB | Air Assessment Branch |
| AQS | Air Quality System |
| AQI..... | Air Quality Index |
| BAM | Beta Attenuation Monitor |
| BC | Black Carbon |
| BP..... | Barometric Pressure |
| CAA | Clean Air Act |
| CFR..... | Code of Federal Regulations |
| CO | Carbon Monoxide |
| CO ₂ | Carbon Dioxide |
| FEM | Federal Equivalent Method |
| FRM | Federal Reference Method |
| EPA | United States Environmental Protection Agency |
| IMPROVE | Interagency Monitoring of Protected Visual Environments |
| MassDEP | Massachusetts Department of Environmental Protection |
| NAAQS..... | National Ambient Air Quality Standards (for criteria pollutants) |
| NATTS..... | National Air Toxics Trends Station |
| NCore | National Core Monitoring Network |
| NO..... | Nitric Oxide |
| NO _x | Nitrogen Oxides |
| NO _y | Total Reactive Oxidized Nitrogen |
| NO ₂ | Nitrogen Dioxide |
| NO ₃ | Nitrate |
| O ₃ | Ozone |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PAMS..... | Photochemical Assessment Monitoring Stations |
| Pb | Lead |
| pH..... | Concentration of hydrogen cations (H ⁺) in solution (an indicator of acidity) |
| ppb | parts per billion by volume |
| ppm | parts per million by volume |
| PM _{2.5} | Particulate matter ≤ 2.5 microns aerodynamic diameter |
| PM ₁₀ | Particulate matter ≤ 10 microns aerodynamic diameter |
| QA/QC | Quality Assurance and Quality Control |
| RH..... | Relative Humidity |
| SIP | State Implementation Plan |
| SO ₂ | Sulfur Dioxide |
| SO ₄ | Sulfate |
| SR..... | Solar Radiation |
| SVOC | Semi-Volatile Organic Compounds |
| TEMP..... | Temperature |
| TSA | Technical Systems Audit |
| TSP..... | Total Suspended Particulates |
| µg/m ³ | micrograms per cubic meter |
| VOCs | Volatile Organic Compounds |
| WS/WD..... | Wind Speed/Wind Direction |
| WSv/WDv..... | Wind Speed/Wind Direction Vector |

Section I

Ambient Air Monitoring Program

Program Overview

Introduction

The Massachusetts Department of Environmental Protection (MassDEP) is the state agency responsible for monitoring outdoor air quality in Massachusetts and developing plans and regulatory programs to reduce emissions of pollutants that adversely affect public health, welfare, and the environment.

MassDEP's Air Assessment Branch (AAB) operates an extensive network of air monitoring stations throughout the Commonwealth. During 2017, MassDEP operated a network of 23 monitoring stations located in 18 cities and towns. MassDEP also received data from the Wampanoag Tribe of Gay Head (Aquinnah), which operates an air monitoring station on Martha's Vineyard.

MassDEP submits all ambient air quality data to the national Air Quality System (AQS) database that is administered by the U.S. Environmental Protection Agency (EPA). Real time data is sent to AIRNOW, which reports all U.S. sites. MassDEP's MassAir Online website provides air quality information and allows users to point and click on a map of the state to find current air quality data from the MassDEP continuous air monitoring network. MassAir Online is found at www.mass.gov/eea/agencies/massdep/air/quality/. EPA also makes historical AQS data for all U.S. sites available at <https://www.epa.gov/outdoor-air-quality-data>.

Why is Air Quality Data Collected?

Ambient air quality data is used for a number of purposes, including to:

- Provide information about air quality to the public;
- Provide short-term and long-term information regarding air pollution and public health;
- Verify compliance with National Ambient Air Quality Standards;
- Assess the effectiveness of current air pollution control regulations and initiatives;
- Support development of policies and regulations aimed at reducing air pollution;
- Support long-term trend analysis and special research; and
- Fulfill requirements to report ambient air quality data to EPA.

What is Monitored?

MassDEP monitors parameters in the following categories:

Criteria pollutants for which EPA has established National Ambient Air Quality Standards (NAAQS). The criteria pollutants monitored are:

- sulfur dioxide (SO₂)
- ozone (O₃)
- carbon monoxide (CO)
- nitrogen dioxide (NO₂)
- lead (Pb)
- particulate matter ≤10 microns (PM₁₀)
- particulate matter ≤2.5 microns (PM_{2.5})

Non-criteria pollutants do not have National Ambient Air Quality Standards, but can contribute to the formation of ozone and particulate matter and/or be toxic. The non-criteria pollutants monitored include:

- nitric oxide (NO)
- total nitrogen oxides (NO_x)
- total reactive oxidized nitrogen (NO_y)
- volatile organic compounds (VOCs) – ozone precursors and reaction product chemicals
- black carbon (i.e., soot)
- toxics – health-relevant VOCs, semi-volatile organic compounds (SVOCs), carbonyls and metals

Meteorological parameters monitored include:

- wind speed/wind direction (WS/WD) and vector (WSv/WDv)
- relative humidity (REL)
- temperature (TEM)
- barometric pressure (BP)
- solar radiation (SUN)
- precipitation (PRECIP)

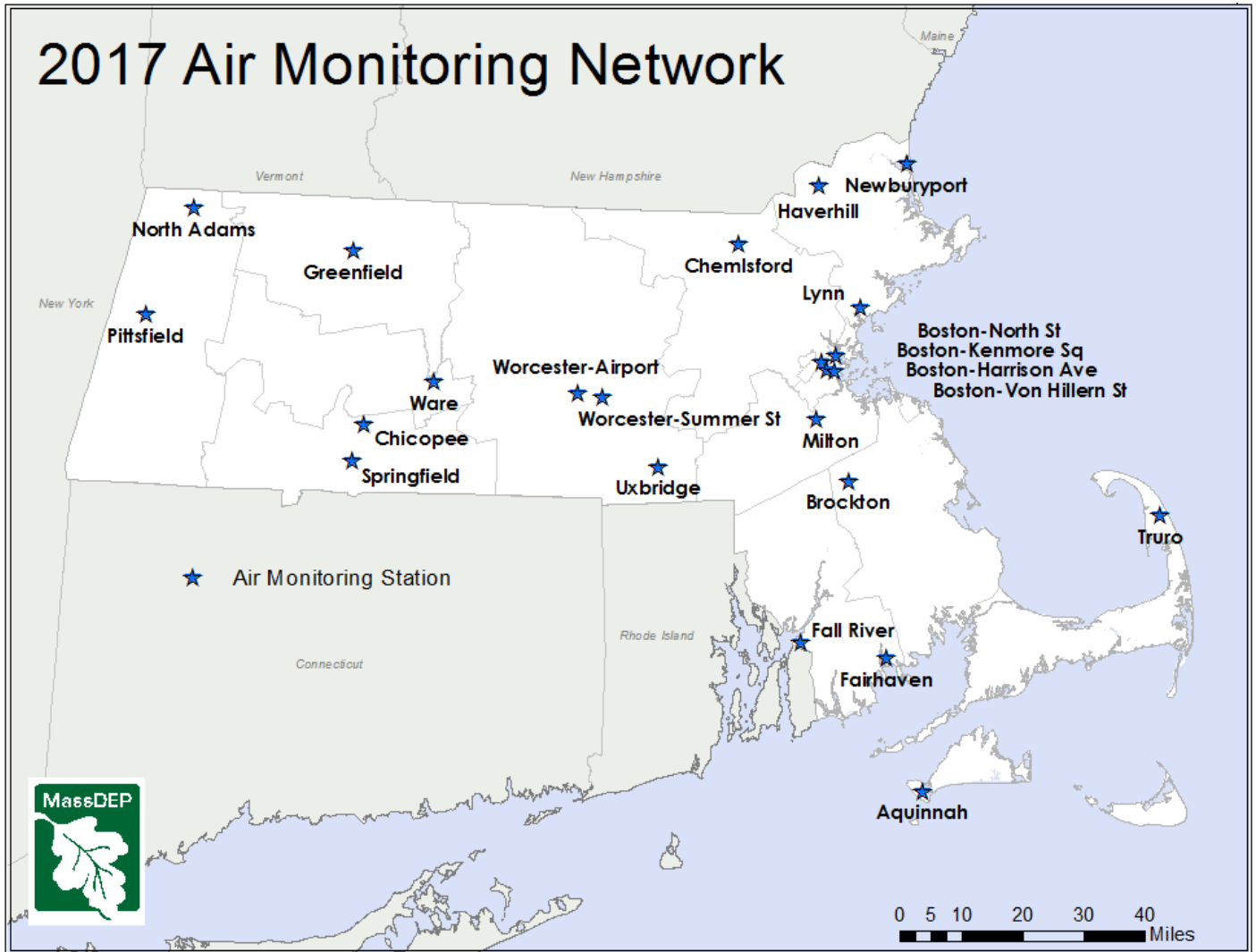
Monitoring Station Locations

Monitoring stations are sited to provide data for various purposes. Some are located where maximum pollutant concentrations are expected, while others are positioned in areas that will provide data that is representative of larger geographical areas. Local topography and pollutant source areas are factors that determine how well a particular monitor's location will represent a region.

Networks of monitors are located throughout the state. These networks are designed to reflect pollutant concentrations for all of Massachusetts. Section III of this report contains data summaries for each pollutant measured and maps showing the monitor locations for each network. Appendix A contains a list of monitor locations.

The map on page 3 shows Massachusetts cities and towns where air monitors were located during 2017.

2017 Air Monitoring Network



National Ambient Air Quality Standards

Below are the current National Ambient Air Quality Standards for criteria pollutants set by EPA.

Primary Standards are designed to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. **Secondary Standards** are designed to protect public welfare, including protection against decreased visibility, damage to crops, vegetation, and buildings.

| National Ambient Air Quality Standards | | | | | |
|--|-------------------|-----------------------|-------------------------|------------------------|---|
| Pollutant | | Primary/ Secondary | Averaging Time | Level | Form |
| Carbon Monoxide | | Primary | 8-hour | 9 ppm | Not to be exceeded more than once per year |
| | | | 1-hour | 35 ppm | |
| Lead | | Primary and secondary | Rolling 3 month average | 0.15 µg/m ³ | Not to be exceeded |
| Nitrogen Dioxide | | Primary | 1-hour | 100 ppb | 98 th percentile, averaged over 3 years |
| | | Primary and secondary | Annual | 0.053 ppm | Annual Mean |
| Ozone | | Primary and secondary | 8-hour | 0.070 ppm | Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years |
| Particle Pollution | PM _{2.5} | Primary | Annual | 12 µg/m ³ | Annual mean, averaged over 3 years |
| | | Secondary | Annual | 15 µg/m ³ | Annual mean, averaged over 3 years |
| | | Primary and secondary | 24-hour | 35 µg/m ³ | 98 th percentile, averaged over 3 years |
| | PM ₁₀ | Primary and secondary | 24-hour | 150 µg/m ³ | Not to be exceeded more than once per year on average over 3 years |
| Sulfur Dioxide | | Primary | 1-hour | 75 ppb | 99 th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| | | Secondary | 3-hour | 0.5 ppm | Not to be exceeded more than once per year |

µg/m³ = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion

Pollutant Health Effects and Sources

Ozone (O₃)

- Tropospheric O₃ (ground-level) and Stratospheric O₃ (upper atmosphere) are the same chemical compound, just found at different places in the atmosphere. Stratospheric O₃ found at greater than 30,000 feet above the surface of the earth is beneficial to all life because it filters out the sun's harmful UV radiation before it reaches the earth's surface. Ground-Level O₃ on the other hand is a health and environmental problem. This report pertains exclusively to ground-level O₃.
- O₃ is a respiratory irritant and can reduce lung function and cause asthma attacks, nasal congestion, and throat irritation, and reduce resistance to infection. It can inflame and damage (possibly permanently) cells that line the lungs, and aggravate chronic lung diseases. In addition, a number of studies have found a strong link between increases in ground-level O₃ and increased risk of premature death.
- O₃ is toxic to vegetation, inhibiting growth and causing leaf damage.
- O₃ deteriorates materials such as rubber and fabrics.
- Ground-level O₃ is unique in that it is formed by the reactions that occur between certain pollutants in the presence of intense, high-energy sunlight during the hot summer months. The complexity of the reactions and the amount of time needed to complete these reactions can result in the buildup of ground-level ozone concentrations far downwind from the original source of the precursors.
- Sources of ground-level O₃ precursors, i.e., nitrogen oxides and hydrocarbons, include motor vehicles, lawn and garden equipment, power plants and other industrial sources.

Carbon Monoxide (CO)

- CO binds with hemoglobin in the blood, reducing the amount of oxygen carried to organs and tissues.
- Symptoms of high CO exposure include shortness of breath, chest pain, headaches, confusion, and loss of coordination. The health threat is most severe for those with cardiovascular disease.
- Motor vehicle emissions are the largest source of CO, which is produced from incomplete combustion of carbon in fuels.
- Industrial processes and non-transportation fuel combustion (e.g., boilers, lawn and garden equipment) also are sources of CO.

Sulfur Dioxide (SO₂)

- SO₂ combines with water vapor to form acidic aerosols harmful to the respiratory tract, aggravating symptoms associated with lung diseases such as asthma and bronchitis.
- SO₂ is a primary contributor to acid deposition. Impacts of acid deposition include: acidification of lakes and streams, damage to vegetation, damage to materials, and diminution of visibility.
- SO₂ is a product of fuel combustion (e.g., the burning of coal and oil that contains sulfur). Sources include power plants and business and residential sources burning heating oil.

Nitrogen Dioxide (NO₂)

- NO₂ lowers resistance to respiratory infections and aggravates symptoms associated with asthma and bronchitis.
- NO₂ contributes to acid deposition. Impacts of acid deposition include: acidification of lakes and streams, damage to vegetation, damage to materials, and diminution of visibility.
- NO₂ and NO contribute to the formation of ozone.
- NO₂ is formed from the oxidation of nitric oxide (NO). Major sources of NO are fuel combustion, space heating, power plants and motor vehicles.

Particulate Matter (PM₁₀ and PM_{2.5})

- Particulate matter is tiny airborne particles or aerosols, which include dust, dirt, soot, smoke, and liquid droplets. Fine particulate matter (mostly below 2.5 microns in size) are not only the result of direct emissions, but can be formed in the atmosphere by chemical reactions involving gaseous pollutants.
- The numbers 2.5 and 10 refer to the particle size (actually the particles equal to or less than that size), measured in microns, which are collected by the monitors. Several thousand PM_{2.5} particles could fit on the period at the end of this sentence.
- The small size of these particles allows easy entry into the human respiratory system. Long-term exposure causes the particles to accumulate in the lungs and affects breathing and produces respiratory symptoms. The small particles can migrate through the lungs and into the circulatory system and potentially produce cardio-vascular symptoms, as well as impacts from toxic components contained in the particulate matter.
- Particulate matter causes soiling and corrosion of materials.
- Particulate matter contributes to atmospheric haze that degrades visibility.
- Sources of particulates include industrial process emissions, motor vehicles, incinerators, power plants, and other fuel combustion sources.

Lead (Pb)

- Lead is an elemental metal that is found in nature.
- Exposure to lead can occur by inhalation or ingestion with food, water, soil or dust particles.
- Children, infants, and fetuses are the most susceptible to the effects of lead exposure.
- Lead causes intellectual disability, brain damage, and liver disease. It may be a factor in high blood pressure and damages the nervous system.
- Lead enters the atmosphere from the incineration of lead containing materials and from the manufacture and processing of lead containing products or materials like storage batteries, smelting and removal of paint that contained lead.

Monitoring Network Description

The following describes the ambient air monitoring network in 2017.

Network Size

- 23 monitoring stations
- 18 cities and towns with monitoring stations

Number of Continuous Monitors

Continuous monitors measure air quality 24 hours per day. The data are reported as hourly means.

- Criteria pollutant monitors measure pollutants for which National Ambient Air Quality Standards (NAAQS) have been set.
 - ❑ 6 – CO (carbon monoxide), which includes 5 trace-level CO monitors
 - ❑ 10 – NO₂ (nitrogen dioxide). NO (nitric oxide) and NO_x (total nitrogen oxides) also are measured by these monitors
 - ❑ 16 – O₃ (ozone)
 - ❑ 6 – SO₂ (sulfur dioxide), which includes 4 trace-level SO₂ monitors
 - ❑ 13 – PM_{2.5} (particulate matter – 2.5 microns) Beta Attenuation Monitors (BAMs)
- Meteorological monitors track weather conditions.
 - ❑ 13 – BP (barometric pressure)
 - ❑ 13 – RH (relative humidity)
 - ❑ 13 – SUN (solar radiation)
 - ❑ 13 – TEMP (temperature)
 - ❑ 13 – WS/WD (wind speed/wind direction)
 - ❑ 1 – WSV/WDV (wind speed vector/wind direction vector)
 - ❑ 2 – Precipitation
- Other Monitors
 - ❑ 3 – NO/NO_y (Total Reactive Oxidized Nitrogen)
 - ❑ 2 – PAMS (photochemical assessment monitoring station) These monitors measure VOCs (volatile organic compounds) using automated gas chromatographs (GCs) on an hourly basis during the summer
 - ❑ 6 – Black Carbon

**Number of
Intermittent
Monitors**

Intermittent monitors take discrete samples for a specific time period. The samples are taken every day, every third day, or every sixth day. The data are averaged in 3-hour or 24-hour intervals.

- Criteria pollutant monitors measure pollutants that have National Ambient Air Quality Standards (NAAQS).
 - 5 – PM₁₀ (particulate matter – 10 microns)
 - 16 – PM_{2.5} FRM (particulate matter – 2.5 microns Federal Reference Method)
- Non-criteria pollutant monitors measure pollutants that do not have NAAQS.
 - 2 – PAMS (photochemical assessment monitoring station). These monitors measure volatile organic compounds (VOCs), which lead to ozone formation.
 - 2 – Toxics. These monitors measure health-relevant VOCs.
 - 2 – Speciation. These monitors measure for PM_{2.5}, nitrates, and organics
 - 1 – PM₁₀ (particulate matter – 10 microns) for metals analysis

Section II

Attainment of Air Quality Standards

Attainment Status Summary

The federal Clean Air Act (CAA) contains timeframes and milestones for states to meet and maintain National Ambient Air Quality Standards (NAAQS) for criteria pollutants, which include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. EPA sets NAAQS at levels to protect public health and the environment. The EPA must review each NAAQS every five years and may update the standards based on new scientific information as well as establish new monitoring requirements. Each state is required to monitor the ambient air to determine whether it meets each standard.¹ If monitoring shows that the air quality does not meet a standard, the state must develop and implement pollution control strategies to attain that standard. Once air quality meets a standard, a state must develop a plan to maintain that standard while accounting for future economic and emissions growth. Taken together, these plans and control strategies constitute the State Implementation Plan (SIP).

Carbon Monoxide

Monitored levels of CO in Massachusetts meet the CO standards. Prior to the mid-1980s, Massachusetts was in nonattainment of the CO standards. However, with the adoption of numerous control programs, CO emissions significantly decreased and monitored levels of CO met the standards beginning in 1987. Massachusetts is designated as Attainment for the CO standards. Based on EPA's most recent review of the CO standards, in August 2011, EPA retained the existing primary CO standards of 9 ppm measured over 8 hours, and 35 ppm measured over 1 hour. Since EPA did not change the standards, no new designation process was triggered.

Lead

Monitored levels of lead in Massachusetts meet the lead standards. In October 2008, EPA lowered the lead standards (primary and secondary) from 1.5 µg/m³ to 0.15 µg/m³ averaged over a rolling 3-month period. In November 2011, EPA designated all of Massachusetts as Unclassifiable/Attainment for the 2008 standards. Based on EPA's most recent review of the lead standards, in September 2016, EPA retained the existing lead standards. Since EPA did not change the standards, no new designation process was triggered.

Nitrogen Dioxide

Monitored levels of NO₂ in Massachusetts meet the NO₂ standards. Based on EPA's most recent review of the NO₂ standards, in January 2010, EPA established a new 1-hour NO₂ primary standard of 100 ppb and new near-road monitoring requirements. In January 2012, EPA designated all of Massachusetts as Unclassifiable/Attainment for the 2010 standard.

¹ MassDEP develops an annual Ambient Air Monitoring Network Plan that describes recent and planned changes to the statewide monitoring network, available at www.mass.gov/eea/agencies/massdep/air/reports/annual-ambient-air-quality-monitoring-network-plan.html.

Sulfur Dioxide

Monitored levels of SO₂ in Massachusetts meet the SO₂ standards. Based on EPA's most recent review of the SO₂ standards, in June 2010, EPA established a new 1-hour SO₂ primary standard of 75 ppb. In December 2017, EPA designated all of Massachusetts as Unclassifiable/Attainment for the 2010 standard.

Particulate Matter

There are standards for two types of particulate matter: PM₁₀ and PM_{2.5}. Monitored levels of PM₁₀ and PM_{2.5} in Massachusetts meet the respective standards.

Based on EPA's most recent review of the PM_{2.5} standards, in December 2012, EPA lowered the primary annual PM_{2.5} standard to 12 µg/m³. In December 2014, EPA designated all of Massachusetts as Unclassifiable/Attainment for the 2012 standard.

Ozone

In 1979, EPA established ozone standards (primary and secondary) set at 0.12 ppm based on the maximum 1-hour ozone concentration that occurred each day during the ozone monitoring season. Massachusetts was designated as Nonattainment with the 1979 standards.

In 1997, EPA established new 8-hour ozone standards (primary and secondary) set at 0.08 ppm that were designed to be more representative of exposure over time, rather than just the maximum concentration (the 1-hour standards were revoked in 2005). Massachusetts was designated as Nonattainment for the 8-hour standards at that time. Through a combination of state and regional controls, Massachusetts' air quality attained the 1997 standards by the 2009 attainment deadline.

In 2008, EPA lowered the 8-hour ozone standards (primary and secondary) to 0.075 ppm. In April 2012, EPA designated Dukes County as Nonattainment for the 2008 ozone standards and designated the remainder of Massachusetts as Unclassifiable/Attainment. Dukes County attained the 2008 ozone standards by the 2015 attainment deadline.

Based on EPA's most recent review of the ozone standards, in October 2015, EPA lowered the 8-hour ozone standards (primary and secondary) to 0.070 ppm. EPA has designated all of Massachusetts as Attainment/Unclassifiable for the 2015 standards.

2017 Ozone Season

In 2017, there were 12 days when the 8-hour ozone standards of 0.070 ppm were exceeded in Massachusetts. Based on the most recent three years of data (2015–2017), two monitors (Chicopee and Fall River) violated the 0.070 ppm standards.

While ozone concentrations have trended downward over the past several decades due to air pollution control programs, ozone concentrations vary each year due to varying weather patterns. In general, the chemical reactions that produce elevated ozone concentrations occur when high energy sunlight (present on hot summer days) facilitates the react of ozone “precursor” pollutants – VOCs and NO_x – which results in ozone formation. Typically, Massachusetts ozone exceedances occur when there is a south or southwesterly airflow that transports elevated levels of ozone, VOCs and NO_x up the coastal urban corridor.

Difference Between Ozone Exceedances and Violations

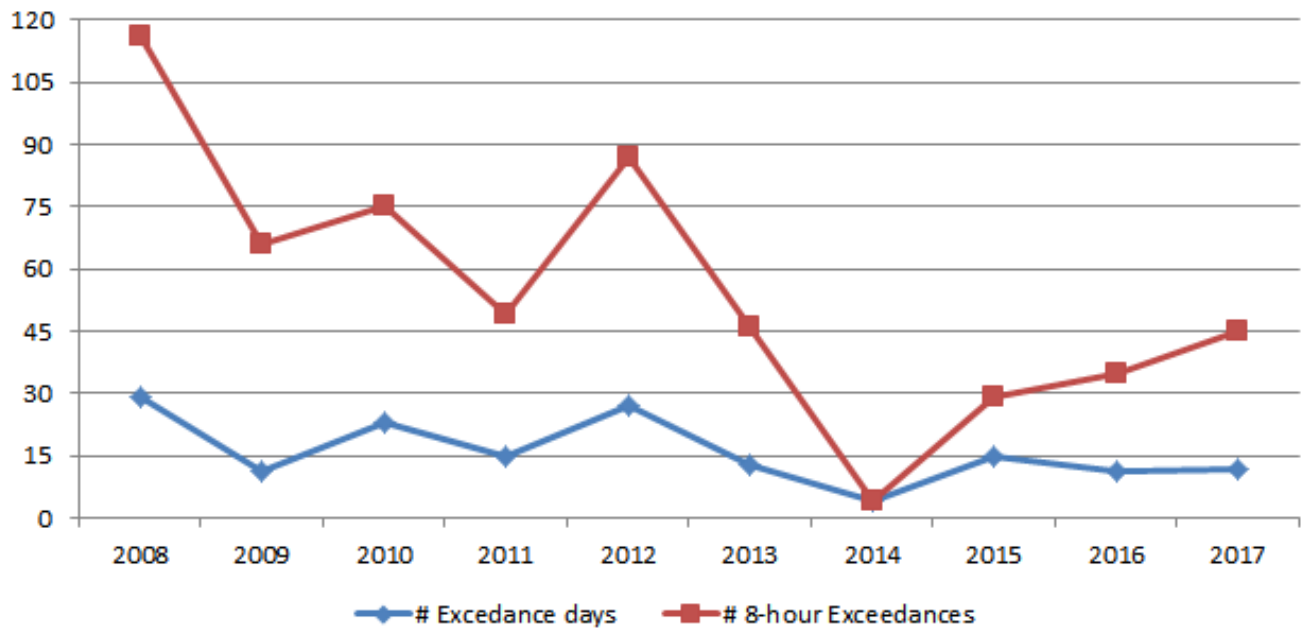
An ozone exceedance occurs when monitored ozone concentrations exceed the ozone NAAQS. Ozone monitoring data is collected as an hourly average of continuous data which is then used to determine the highest 8-hour average value for the day. An exceedance of the 8-hour NAAQS is an 8-hour averaged value that is greater than 0.070 ppm. An ozone exceedance occurs when a monitor records ambient levels of ozone above the NAAQS. Monitoring an ozone exceedance does not mean that a violation of the ozone NAAQS has occurred, because a violation of an ozone NAAQS (as opposed to an exceedance) is based on three-year averages of data at each monitor.

An ozone violation of the 8-hour NAAQS is determined using the annual 4th-highest daily maximum eight-hour ozone value at each monitor. A violation requires a three-year average of the annual 4th-highest daily maximum eight-hour value that is greater than 0.070 ppm. In other words, the eight-hour values for each day during a year for a specific monitor are ranked from highest to lowest. Then, the 4th-highest value for three consecutive years is averaged. If the three-year average is greater than 0.070 ppm, a violation of the 8-hour NAAQS has occurred at that monitoring site.

Exceedance Days and Total Exceedance Trends

Figure 1 shows the trend in the number of 8-hour exceedance days and the total number of exceedances for the past ten years. Note that years 2008-2015 show what exceedances would have been had the 0.070 ppm 8-hour standards been in effect.

Figure 1
8-hour Ozone Exceedance Days and Total Exceedances 2008-2017
Exceedances Based on 0.070 ppm 8-hour Standards



Daily Ozone and PM Forecasts

MassDEP provides the public with daily air quality forecasts for ozone from April through September and for fine particles all year round using weather maps and meteorological factors to predict whether or not conditions will result in elevated pollution levels. The daily air quality forecasts are available from www.mass.gov/eea/agencies/massdep/air/quality/. EPA web sites that contain regional and national pollution forecasts using data that is provided by participating states are located at www.epa.gov/region01/airquality/forecast.html and <http://airnow.gov/>. The table below describes the ratings used in the daily air quality forecasts.

| Air Quality Index (AQI): Ozone | | | Air Quality Index (AQI): Particle Pollution | | |
|---------------------------------------|---------------------------------|--|--|---------------------------------|--|
| Index Values | Levels of Health Concern | Cautionary Statements | Index Values | Levels of Health Concern | Cautionary Statements |
| 0-50 | Good | None | 0-50 | Good | None |
| 51-100 | Moderate | Unusually sensitive people should consider reducing prolonged or heavy exertion outdoors. | 51-100 | Moderate | Unusually sensitive people should consider reducing prolonged or heavy exertion. |
| 101-150 | Unhealthy for Sensitive Groups | Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors. | 101-150 | Unhealthy for Sensitive Groups | People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion. |
| 151-200 | Unhealthy | Active children and adults, and people with lung disease, such as asthma, should avoid prolonged or heavy exertion outdoors. Everyone else, especially children, should reduce prolonged or heavy exertion outdoors. | 151-200 | Unhealthy | People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion. |
| 201-300 | Very Unhealthy | Active children and adults, and people with lung disease, such as asthma, should avoid all outdoor exertion. Everyone else, especially children, should avoid prolonged or heavy exertion outdoors. | 201-300 | Very Unhealthy | People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion. |

Section III

Massachusetts Air Quality Data Summaries

Ozone Summary

2017 Ozone Data Summary

A summary of the data collected during the 2017 ozone season (March 1 – September 30) is shown below (in parts per million). MassDEP operated 15 ozone sites during 2017. The Wampanoag Tribe operated one site in Aquinnah on Martha's Vineyard.

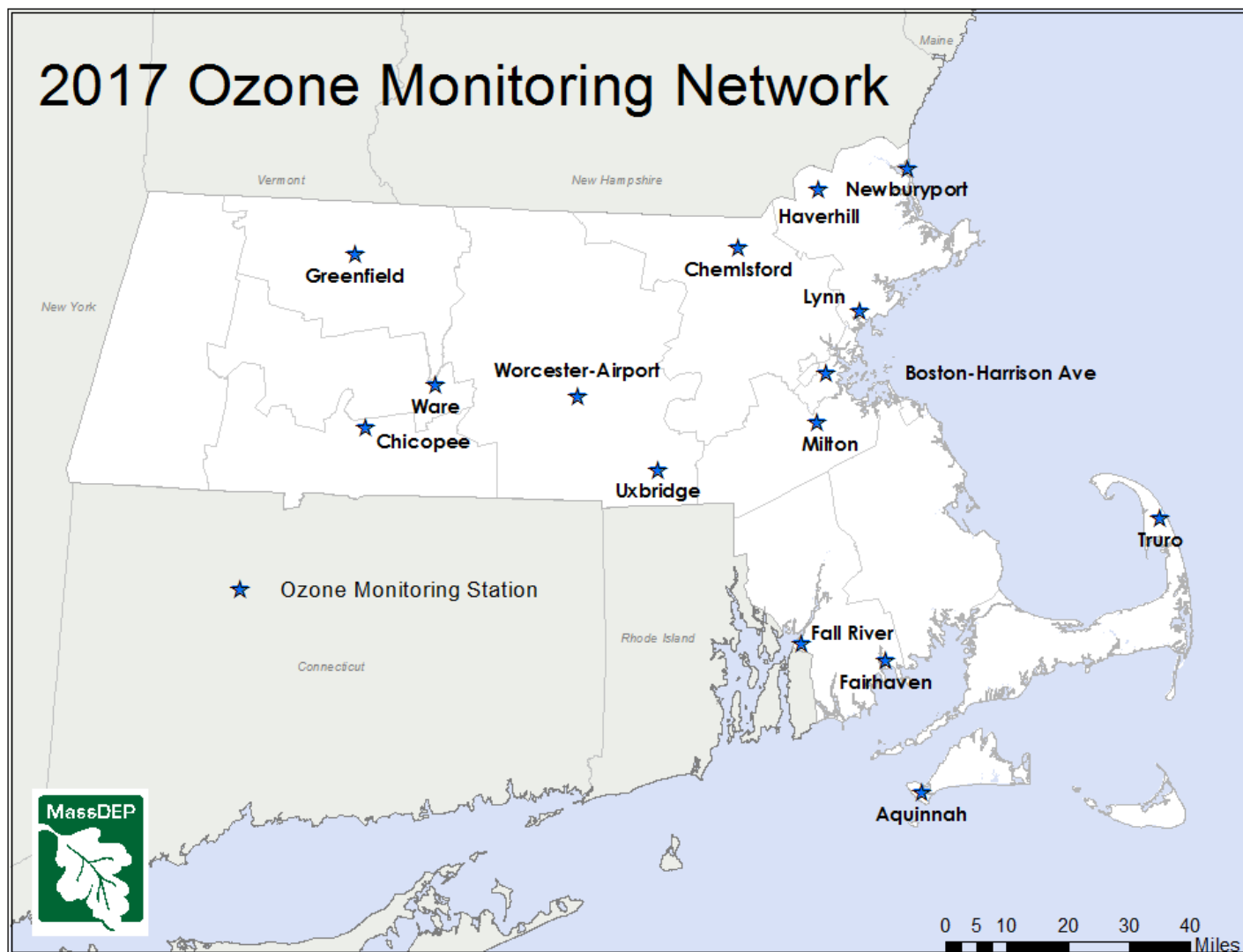
| Ozone 2017 | | | | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | 8-HR MAX>.070 | 1ST MAX | 2ND MAX |
|-------------|-------------|------------|--------------------|------------|------------|------------|------------|------------------|------------|------------|
| SITE ID | CITY | COUNTY | ADDRESS | 8-HR | 8-HR | 8-HR | 8-HR | STD | 1-HR | 1-HR |
| 25-007-0001 | Aquinnah | Dukes | 1 HERRING CREEK RD | 0.096 | 0.095 | 0.083 | 0.076 | 4 | 0.115 | 0.113 |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 0.076 | 0.072 | 0.072 | 0.069 | 3 | 0.099 | 0.086 |
| 25-023-0005 | Brockton | Plymouth | 1 CLINTON ST | 0.084 | 0.074 | 0.073 | 0.072 | 4 | 0.103 | 0.089 |
| 25-017-0009 | Chelmsford | Middlesex | 11 TECHNOLOGY | 0.072 | 0.067 | 0.065 | 0.065 | 1 | 0.093 | 0.088 |
| 25-013-0008 | Chicopee | Hampden | ANDERSON RD AFB | 0.074 | 0.072 | 0.072 | 0.072 | 4 | 0.104 | 0.094 |
| 25-005-1006 | Fairhaven | Bristol | 30 SCHOOL ST | 0.083 | 0.082 | 0.074 | 0.073 | 4 | 0.103 | 0.101 |
| 25-005-1004 | Fall River | Bristol | 659 GLOBE ST | 0.086 | 0.078 | 0.076 | 0.073 | 5 | 0.103 | 0.089 |
| 25-011-2005 | Greenfield | Franklin | VETERANS FIELD | 0.067 | 0.066 | 0.064 | 0.064 | 0 | 0.077 | 0.074 |
| 25-009-5005 | Haverhill | Essex | 685 WASHINGTON | 0.069 | 0.067 | 0.065 | 0.065 | 0 | 0.095 | 0.083 |
| 25-009-2006 | Lynn | Essex | 390 PARKLAND | 0.081 | 0.074 | 0.071 | 0.069 | 3 | 0.099 | 0.084 |
| 25-021-3003 | Milton | Norfolk | BLUE HILL OBSERV | 0.084 | 0.083 | 0.076 | 0.075 | 4 | 0.104 | 0.095 |
| 25-009-4005 | Newburyport | Essex | HARBOR STREET | 0.069 | 0.068 | 0.067 | 0.066 | 0 | 0.092 | 0.083 |
| 25-001-0002 | Truro | Barnstable | FOX BOTTOM AREA | 0.085 | 0.081 | 0.079 | 0.072 | 5 | 0.101 | 0.095 |
| 25-027-0024 | Uxbridge | Worcester | 366 E HARTFORD DR | 0.083 | 0.077 | 0.070 | 0.069 | 2 | 0.110 | 0.095 |
| 25-015-4002 | Ware | Hampshire | QUABBIN SUMMIT | 0.077 | 0.073 | 0.072 | 0.069 | 3 | 0.110 | 0.100 |
| 25-027-0015 | Worcester | Worcester | 375 AIRPORT | 0.076 | 0.073 | 0.072 | 0.068 | 3 | 0.100 | 0.094 |

STANDARDS: 8-hour = 0.070 ppm

ABBREVIATIONS AND SYMBOLS USED IN TABLE

SITE ID = AIRS SITE IDENTIFICATION NUMBER; **1ST, 2ND, 3RD, 4TH MAX 8-HR** = MAXIMUM 8-HOUR VALUE FOR THE 1ST, 2ND, 3RD AND 4TH HIGHEST DAY; **8-HR MAX > .070 STD** = NUMBER OF MEASURED DAILY 8-HOUR MAXIMUM VALUES GREATER THAN THE 0.070 PPM 8-HOUR STANDARD; **1ST, 2ND MAX 1-HR** = MAXIMUM 1-HOUR VALUE FOR THE 1ST AND 2ND HIGHEST DAY

2017 Ozone Monitoring Network



8-hour Ozone Exceedance Trends

Figure 2 shows the trend for each monitor for the past ten years based on the 0.070 ppm 8-hour standards.

Figure 2
8-hour Ozone Exceedance Trends 2008 – 2017
Based on the 0.070 ppm 8-hour Standards

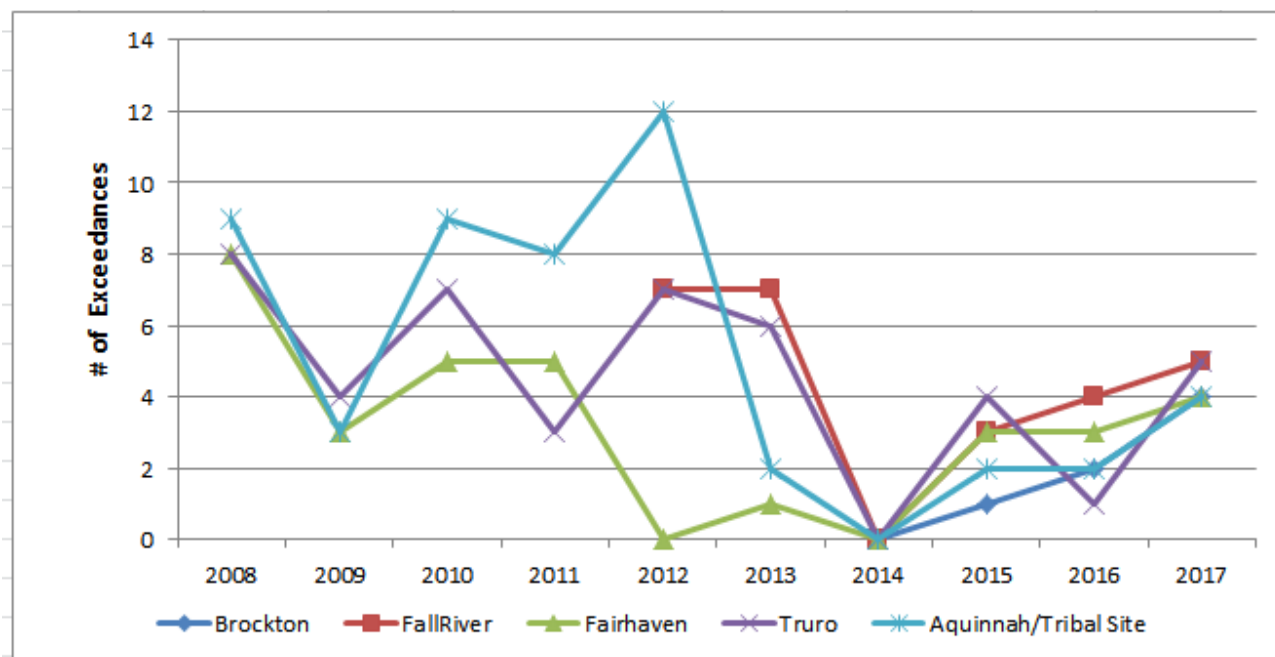
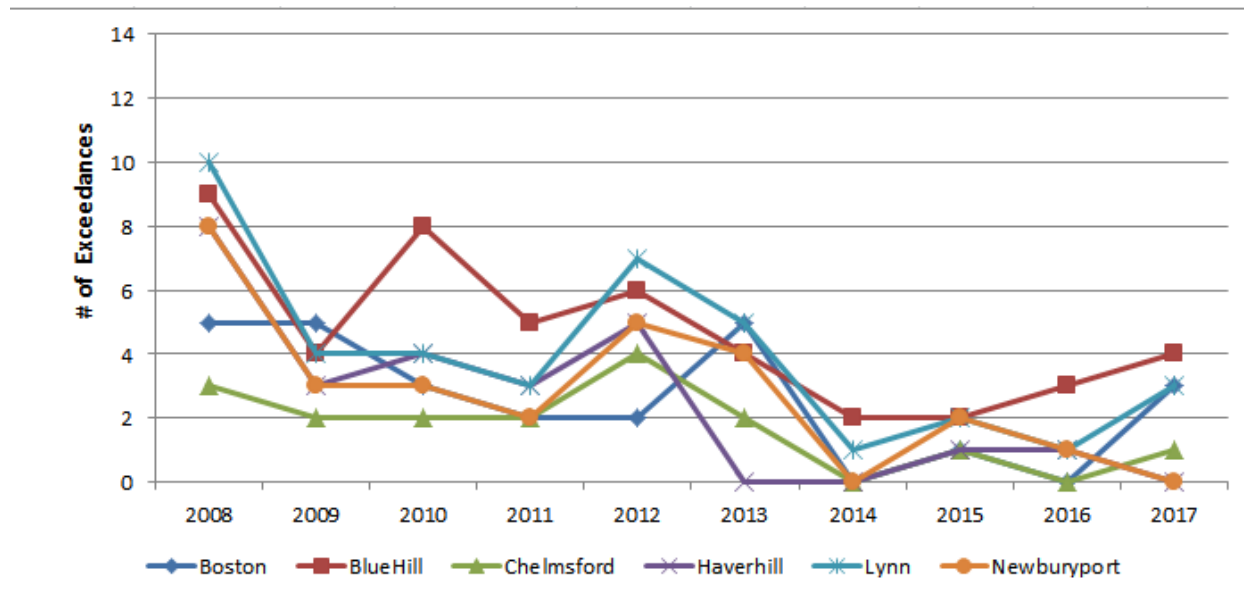
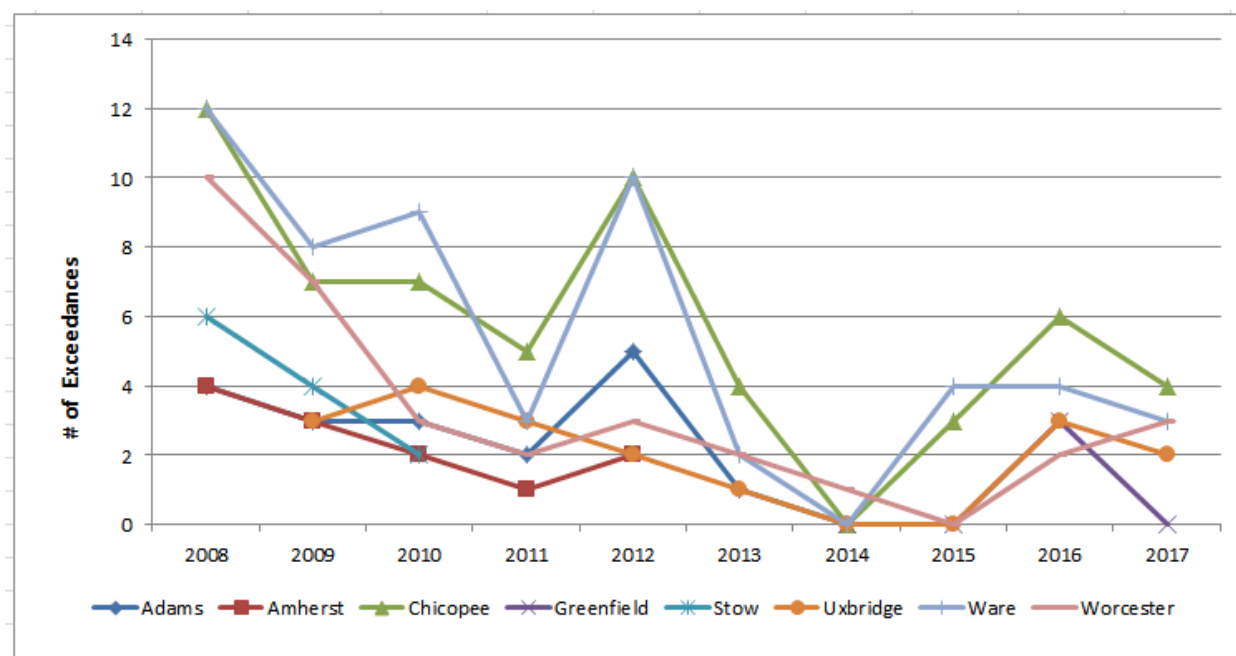


Figure 2 cont.
8-hour Ozone Exceedance Trends 2008 – 2017
 Based on the 0.070 ppm 8-hour Standards



Sulfur Dioxide (SO₂) Summary

2017 SO₂ Data Summary

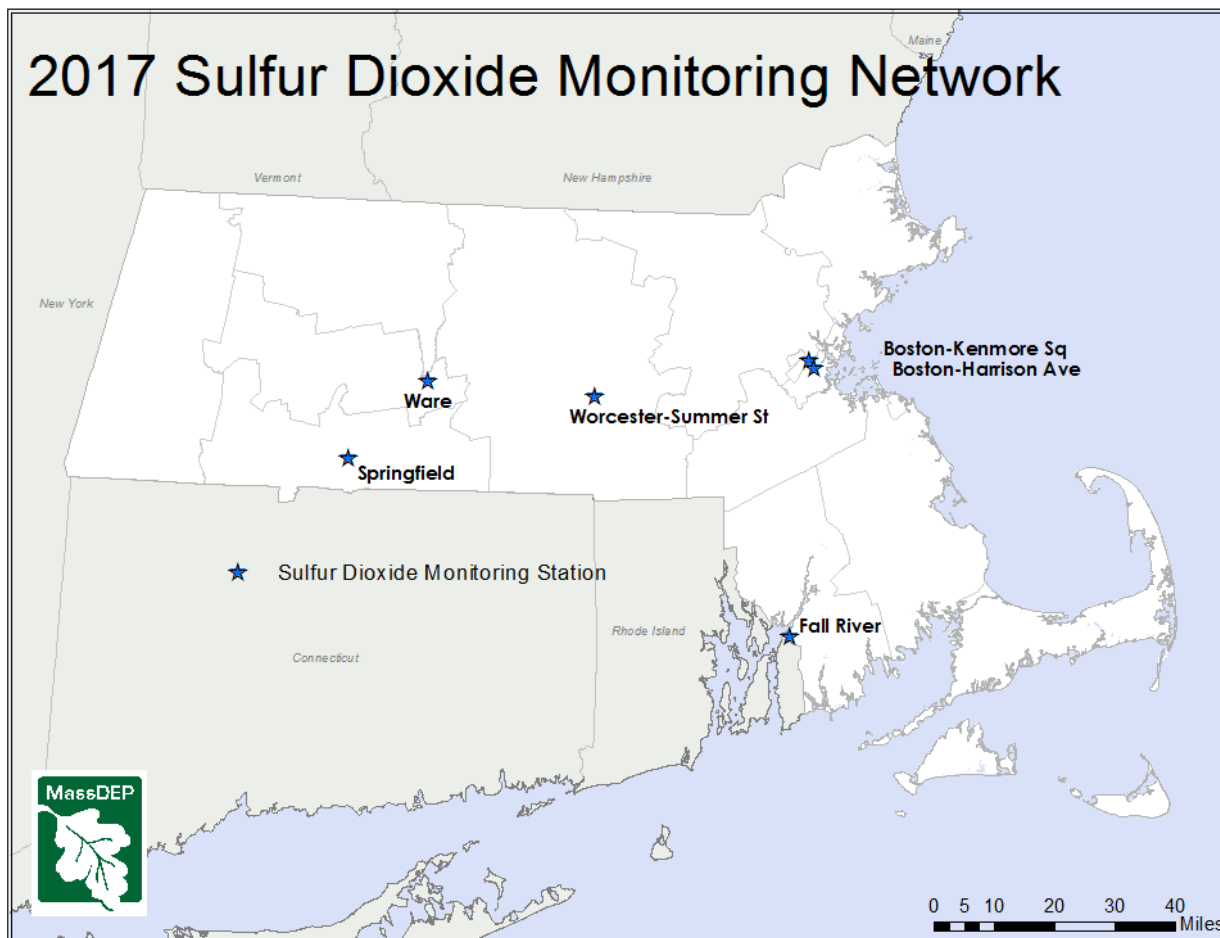
A summary of the 2017 SO₂ data is shown below (in parts per billion). MassDEP operated six SO₂ sites during 2017.

| SO2 2017 | | | 1ST | 2ND | 99TH | | 1ST | 2ND |
|-------------|-----------|----------------|------|------|------|-------|-------|-------|
| CITY | COUNTY | ADDRESS | MAX | MAX | PCTL | ARITH | MAX | MAX |
| | | | 1-HR | 1-HR | 1-HR | MEAN | 24-HR | 24-HR |
| Boston | Suffolk | KENMORE SQ | 8.4 | 3.8 | 2.8 | 0.50 | 1.7 | 1.5 |
| Boston | Suffolk | HARRISON AVE | 5.1 | 4.2 | 4.0 | 0.58 | 2.0 | 1.9 |
| Fall River | Bristol | 659 GLOBE ST | 12.6 | 12.6 | 11.2 | 0.67 | 4.9 | 4.7 |
| Springfield | Hampden | LIBERTY ST | 4.2 | 4.1 | 3.9 | 0.62 | 2.7 | 2.6 |
| Ware | Hampshire | QUABBIN SUMMIT | 3.5 | 1.7 | 1.6 | 0.63 | 1.8 | 1.3 |
| Worcester | Worcester | SUMMER ST | 4.5 | 4.3 | 3.9 | 0.85 | 2.1 | 2.1 |

STANDARDS: 1-hour = 75 ppb 3-hour = 0.5 ppm (500 ppb)

ABBREVIATIONS AND SYMBOLS USED IN TABLE

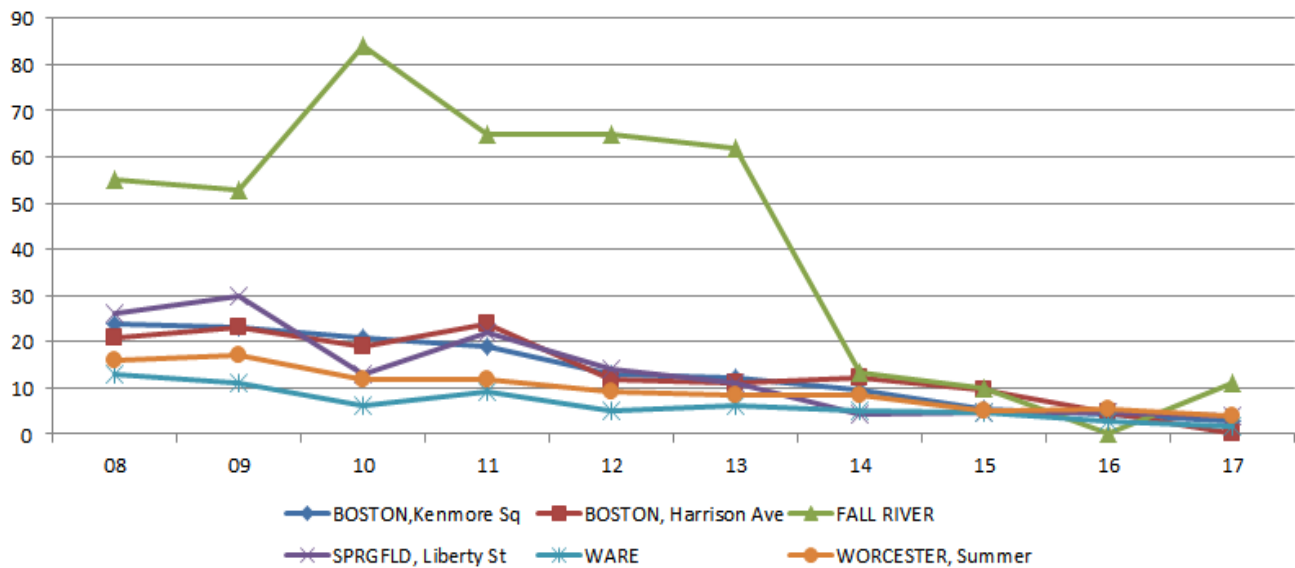
1ST, 2ND MAX 1-HR = FIRST AND SECOND HIGHEST 1-HOUR VALUE; 99TH PCTL 1-HR = 99th PERCENTILE OF THE 1-HOUR MAXIMUM VALUE; ARITH MEAN = ANNUAL ARITHMETIC MEAN; 1ST, 2ND MAX 24-HR = FIRST AND SECOND HIGHEST 24-HOUR VALUE



SO₂ Trends

Figure 3 shows the trend of the 1-hour 99th percentile for each SO₂ site for the past 10 years. The current 1-hour standard is 75 ppb.

Figure 3
Sulfur Dioxide Trends 2008 – 2017
1-hour 99th Percentile Annual Average



Nitrogen Dioxide (NO₂) Summary

2017 NO₂ Data Summary

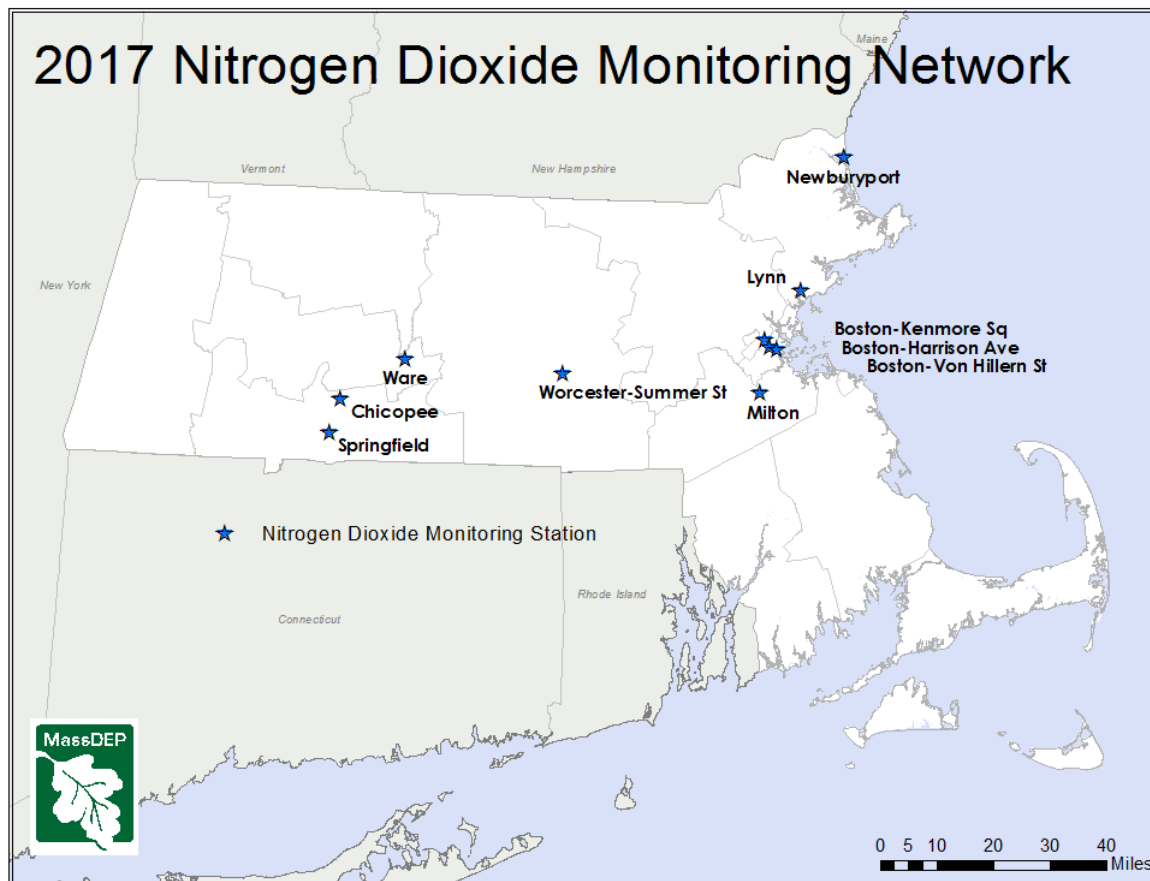
A summary of the 2017 NO₂ data is shown below (in parts per billion). MassDEP operated 10 NO₂ sites during 2017.

| NO2 2017 | | | | 1ST | 2ND | 98TH | |
|-------------|-------------|-----------|-----------------|-------------|-------------|---------------------|---------------|
| SITE ID | CITY | COUNTY | ADDRESS | MAX 1-HR | MAX 1-HR | PERCENTILE VALUE | ARITH MEAN |
| 25-025-0002 | Boston | Suffolk | KENMORE SQ | 57 | 56 | 46 | 25.25 |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 49 | 48 | 46 | 22.14 |
| 25-025-0044 | Boston | Suffolk | 19 VON HILLERN | 56 | 54 | 44 | 25.42 |
| 25-013-0008 | Chicopee | Hampden | ANDERSON RD AFB | 43 | 40 | 37 | 12.87 |
| 25-009-2006 | Lynn | Essex | 390 PARKLAND | 40 | 38 | 32 | 11.92 |
| 25-021-3003 | Milton | Norfolk | 695 HILLSIDE ST | 33 | 33 | 29 | 9.01 |
| 25-009-4005 | Newburyport | Essex | HARBOR STREET | 41 | 39 | 21 | 6.63 |
| 25-013-0016 | Springfield | Hampden | LIBERTY STREET | 55 | 52 | 44 | 23.37 |
| 25-015-4002 | Ware | Hampshire | QUABBIN SUMMIT | 29 | 28 | 20 | 4.89 |
| 25-027-0023 | Worcester | Worcester | SUMMER ST | 59 | 53 | 49 | 23.08 |

STANDARDS: Annual Arithmetic Mean = 53 ppb 1-hour = 100 ppb

ABBREVIATIONS AND SYMBOLS USED IN TABLE

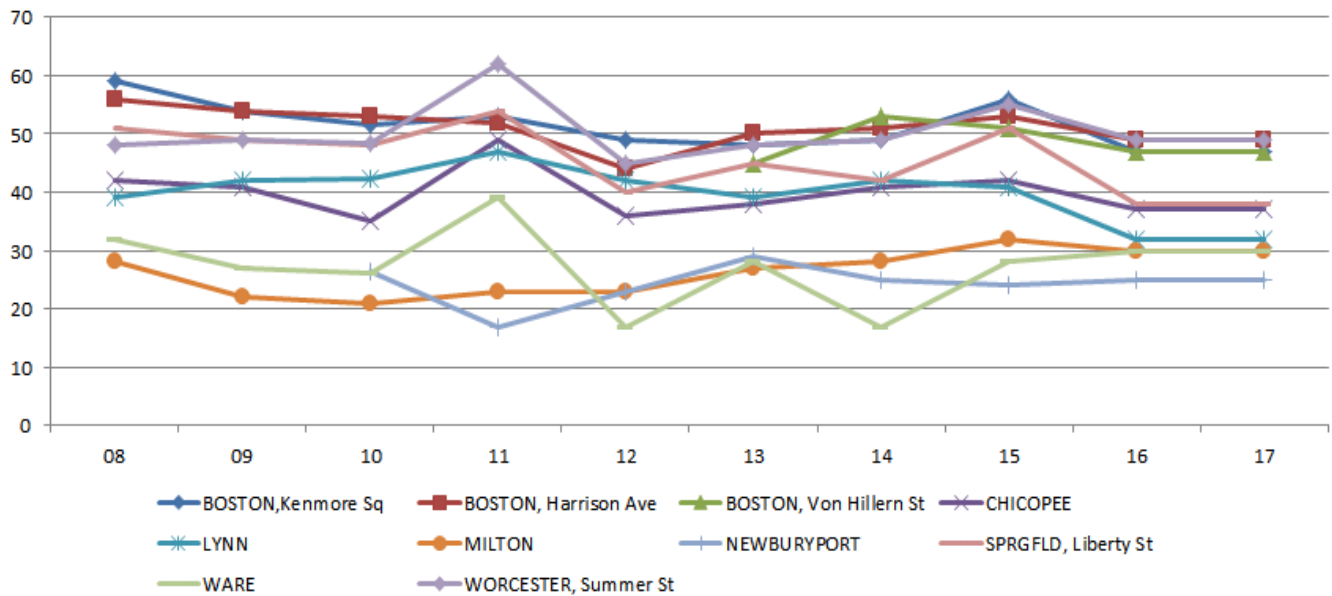
SITE ID = AIRS SITE IDENTIFICATION NUMBER; **1ST**, **2ND** **MAX 1-HR** = FIRST AND SECOND HIGHEST 1-HOUR VALUE; **ARITH MEAN** = ANNUAL ARITHMETIC MEAN



NO₂ Trends

Figure 4 shows the trend of the 1-hour 98th percentile annual average for each NO₂ site over the past 10 years. The current 1-hour standard is 100 ppb.

Figure 4
Nitrogen Dioxide Trends 2008 - 2017
1-hour 98th Percentile Annual Average



Carbon Monoxide (CO) Summary

2017 CO Data Summary

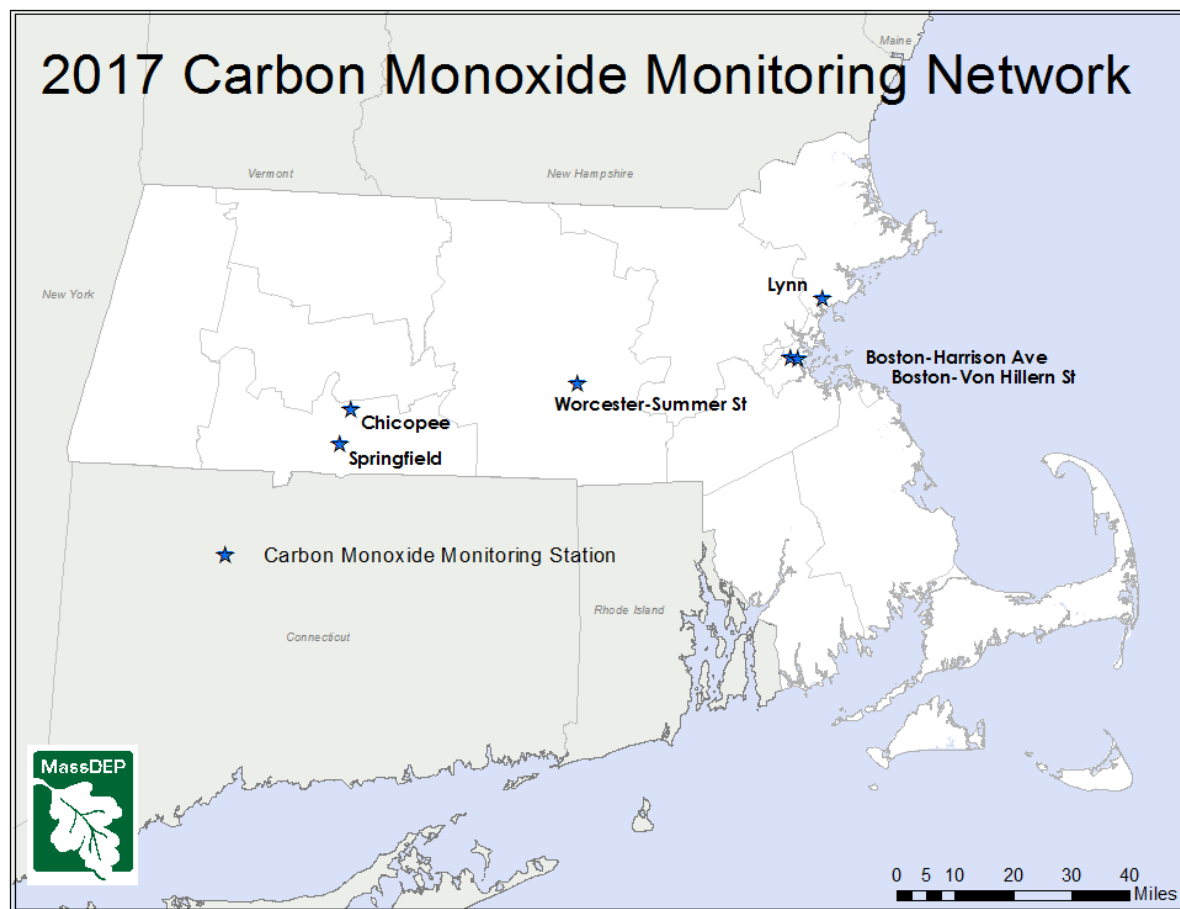
A summary of the 2017 CO data is shown below (in parts per million). MassDEP operated six CO sites during 2017.

| CO 2017 | | | | 1ST MAX 1-HR | 2ND MAX 1-HR | 1ST MAX 8-HR | 2ND MAX 8-HR |
|-------------|-------------|-----------|-----------------|--------------------|--------------------|--------------------|--------------------|
| SITE ID | CITY | COUNTY | ADDRESS | | | | |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 1.472 | 1.320 | 1.260 | 1.256 |
| 25-025-0044 | Boston | Suffolk | 19 VON HILLERN | 1.674 | 1.624 | 1.324 | 1.237 |
| 25-013-0008 | Chicopee | Hampden | ANDERSON RD AFB | 0.936 | 0.767 | 0.753 | 0.728 |
| 25-009-2006 | Lynn | Essex | 390 PARKLAND | 1.059 | 1.043 | 0.943 | 0.612 |
| 25-013-0016 | Springfield | Hampden | LIBERTY STREET | 2.100 | 1.300 | 1.300 | 1.200 |
| 25-027-0023 | Worcester | Worcester | SUMMER ST | 1.217 | 1.149 | 1.1 | 1.1 |

STANDARDS: 1-hour = 35 ppm 8-hour = 9 ppm

ABBREVIATIONS AND SYMBOLS USED IN TABLE

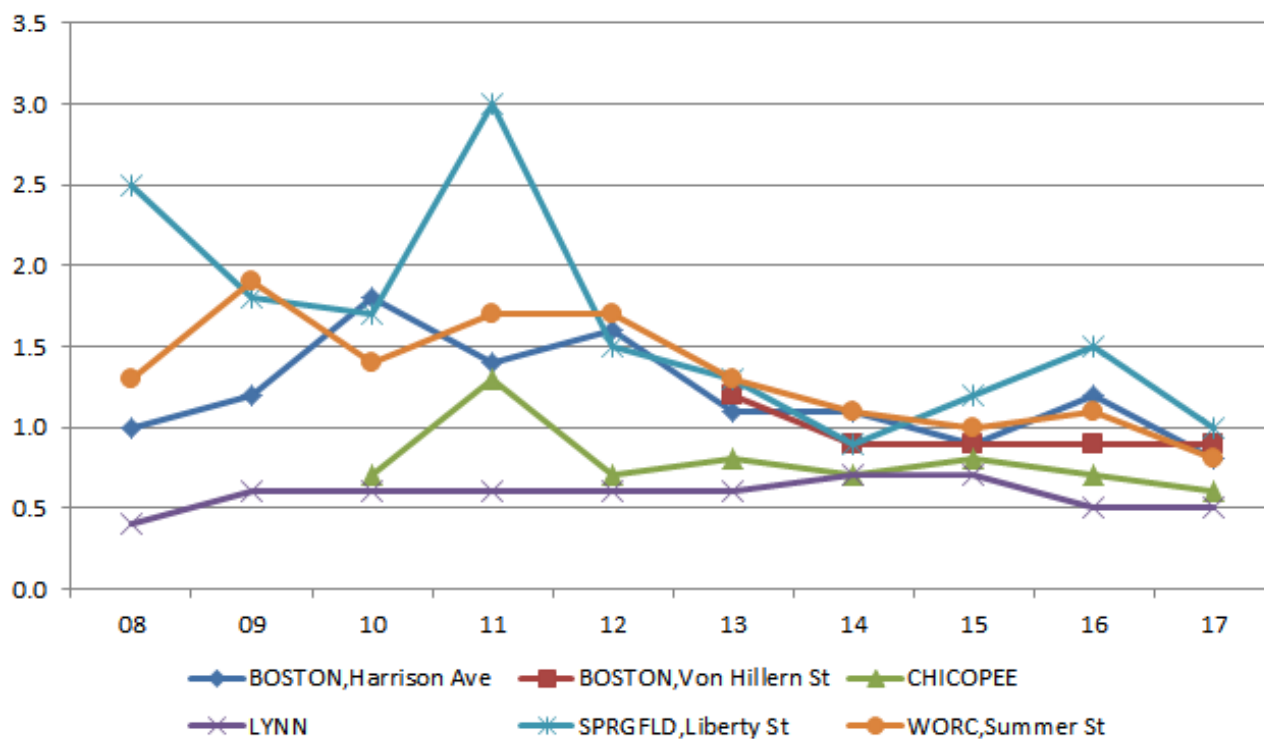
SITE ID = AIRS SITE IDENTIFICATION NUMBER; **1ST, 2ND MAX 1-HR** = FIRST AND SECOND HIGHEST 1-HOUR VALUE; **1ST, 2ND MAX 8-HR** = FIRST AND SECOND HIGHEST 8-HOUR VALUE



CO Trends

Figure 5 shows the trend of the 2nd maximum 8-hour average for each CO site over the past 10 years. The current 8-hour standard is 9 ppm.

Figure 5
Carbon Monoxide Trends 2008-2017
2nd Maximum 8-hour Values



Particulate Matter 10 Microns (PM₁₀) Summary

2017 PM₁₀ Data Summary

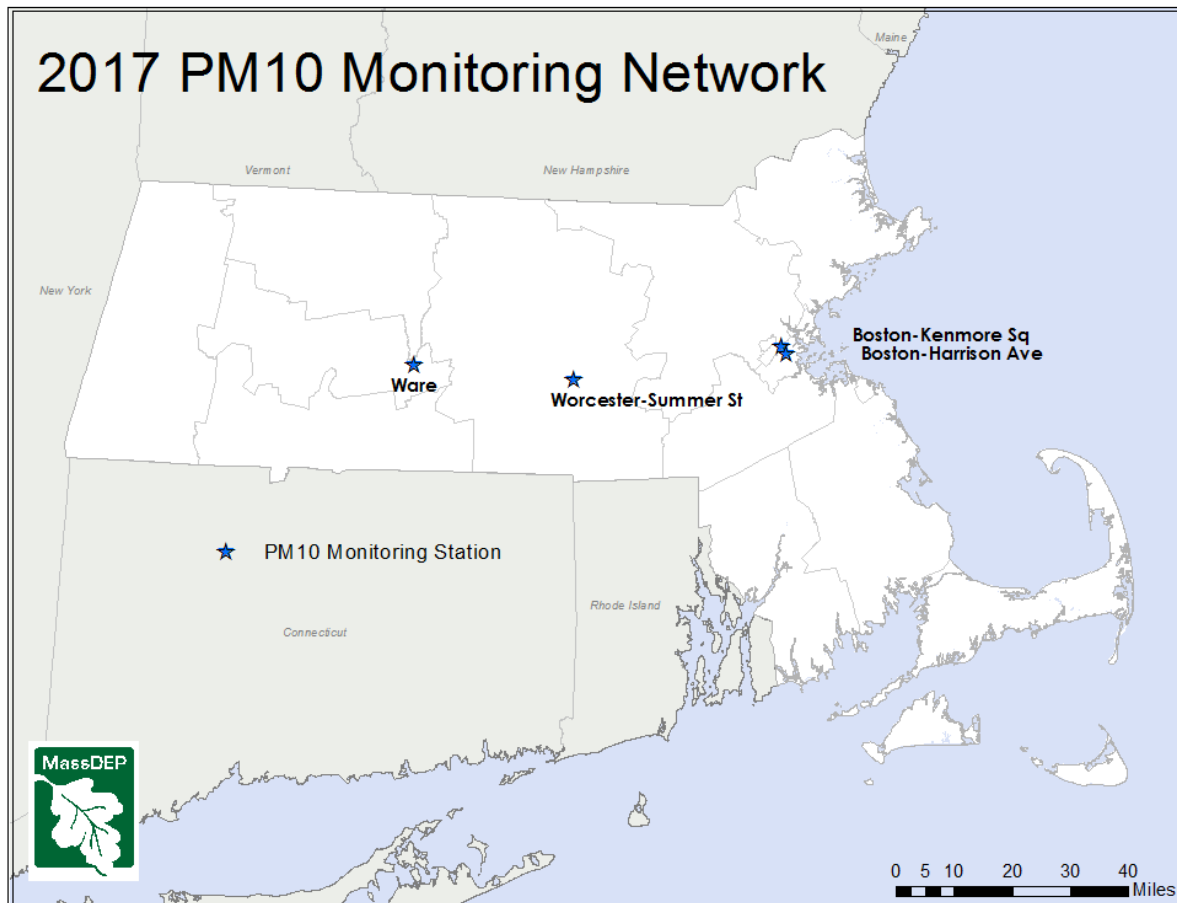
A summary of the 2017 PM₁₀ data is shown below (in $\mu\text{g}/\text{m}^3$). MassDEP operated five PM₁₀ monitors in 2017.

| PM10 2017 | | | | | 1ST | 2ND | 3RD | 4TH | DAYS | |
|-------------|--------|-------------|-----------|----------------|-------|-------|-------|-------|------|-------|
| | | | | | MAX | MAX | MAX | MAX | MAX | ARITH |
| SITE ID | | CITY | COUNTY | ADDRESS | 24-HR | 24-HR | 24-HR | 24-HR | >STD | MEAN |
| 25-013-0016 | | Springfield | Hampden | LIBERTY | 22 | 21 | 19 | 18 | 0 | 11.9 |
| 25-015-4002 | | Ware | Hampshire | QUABBIN SUMMIT | 18 | 18 | 16 | 15 | 0 | 6.0 |
| 25-025-0042 | | Boston | Suffolk | HARRISON AVE | 36 | 27 | 26 | 22 | 0 | 11.2 |
| 25-025-0042 | colloc | Boston | Suffolk | HARRISON AVE | 26 | 22 | 21 | 20 | 0 | 11.0 |
| 25-027-0023 | | Worcester | Worcester | SUMMER ST | 40 | 37 | 34 | 27 | 0 | 14.3 |

STANDARDS: 24-hour = 150 $\mu\text{g}/\text{m}^3$

ABBREVIATIONS AND SYMBOLS USED IN TABLE

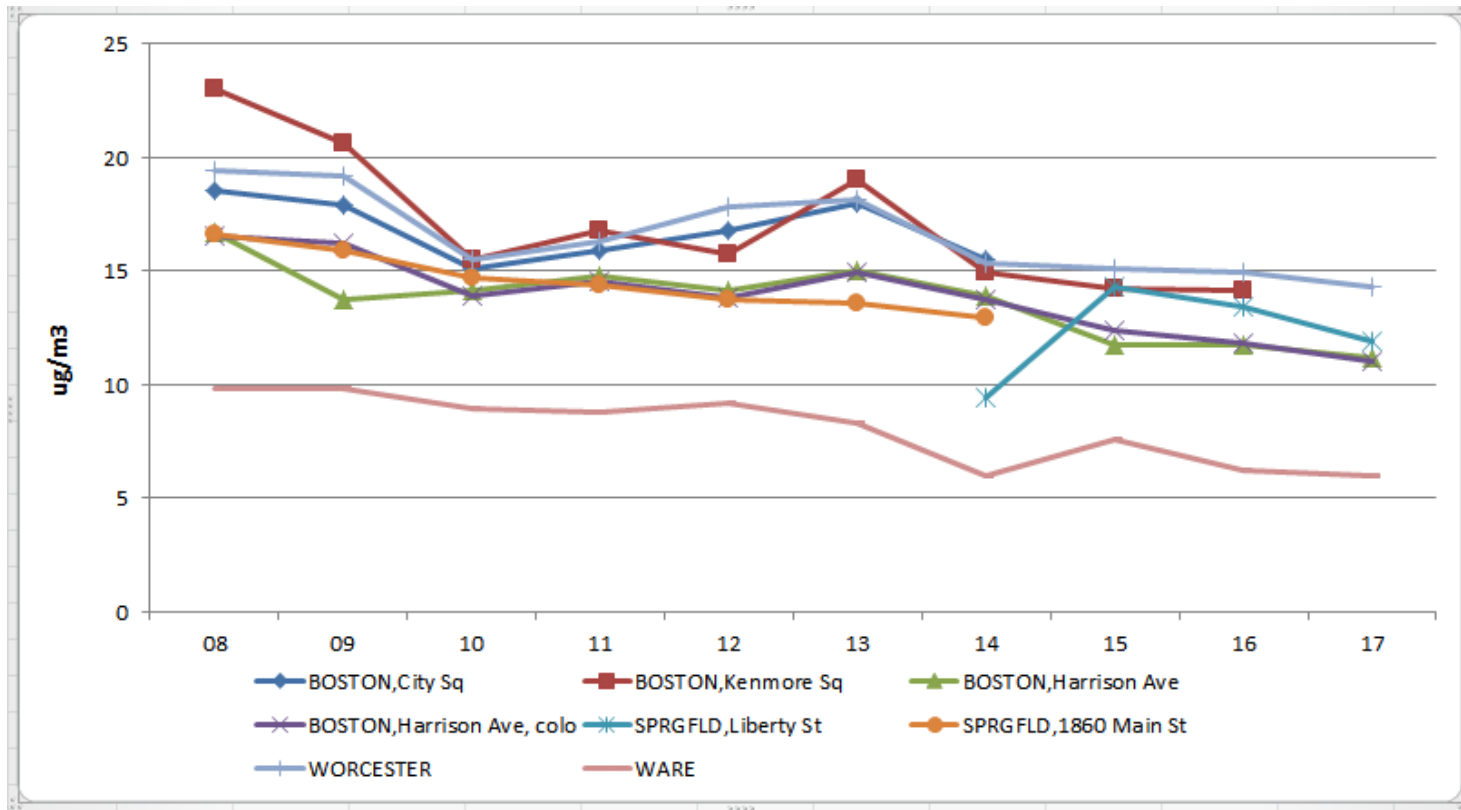
SITE ID = AIRS SITE IDENTIFICATION NUMBER; **COLLOC** = COLLOCATED; **1ST, 2ND, 3RD, 4TH 24-HR MAX** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR; **ARITH MEAN** = ANNUAL ARITHMETIC MEAN



PM₁₀ Trends

Figure 6 shows the trend of for each PM₁₀ site over the past 10 years using the annual arithmetic mean as an indicator.

Figure 6
PM₁₀ Trends 2008-2017
Annual Arithmetic Mean



Particulate Matter 2.5 Microns (PM_{2.5}) Summary

During 2017, MassDEP operated 16 Federal Reference Method (FRM) filter-based PM_{2.5} monitors and 14 Federal Equivalence Method (FEM) continuous PM_{2.5} monitors. FRM monitors require the manual set-up and collection of filters that collect 24-hour samples every three or six days. The filters are weighed prior to placement in the field and then weighed again after the sample is collected to determine the amount of PM_{2.5} collected on the filter. FEM monitors measure PM_{2.5} on an hourly basis. MassDEP operates FRM and FEM monitors side-by-side at some locations for comparison. In general, FEM monitors provide slightly higher values than FRM monitors, which may be due to measurement of fresh hourly PM_{2.5} samples with FEM versus slightly aged 24-hour samples with the FRM filter method.

2017 PM_{2.5} FRM Data Summary

A summary of the 2017 PM_{2.5} FRM data is shown below (in µg/m³).

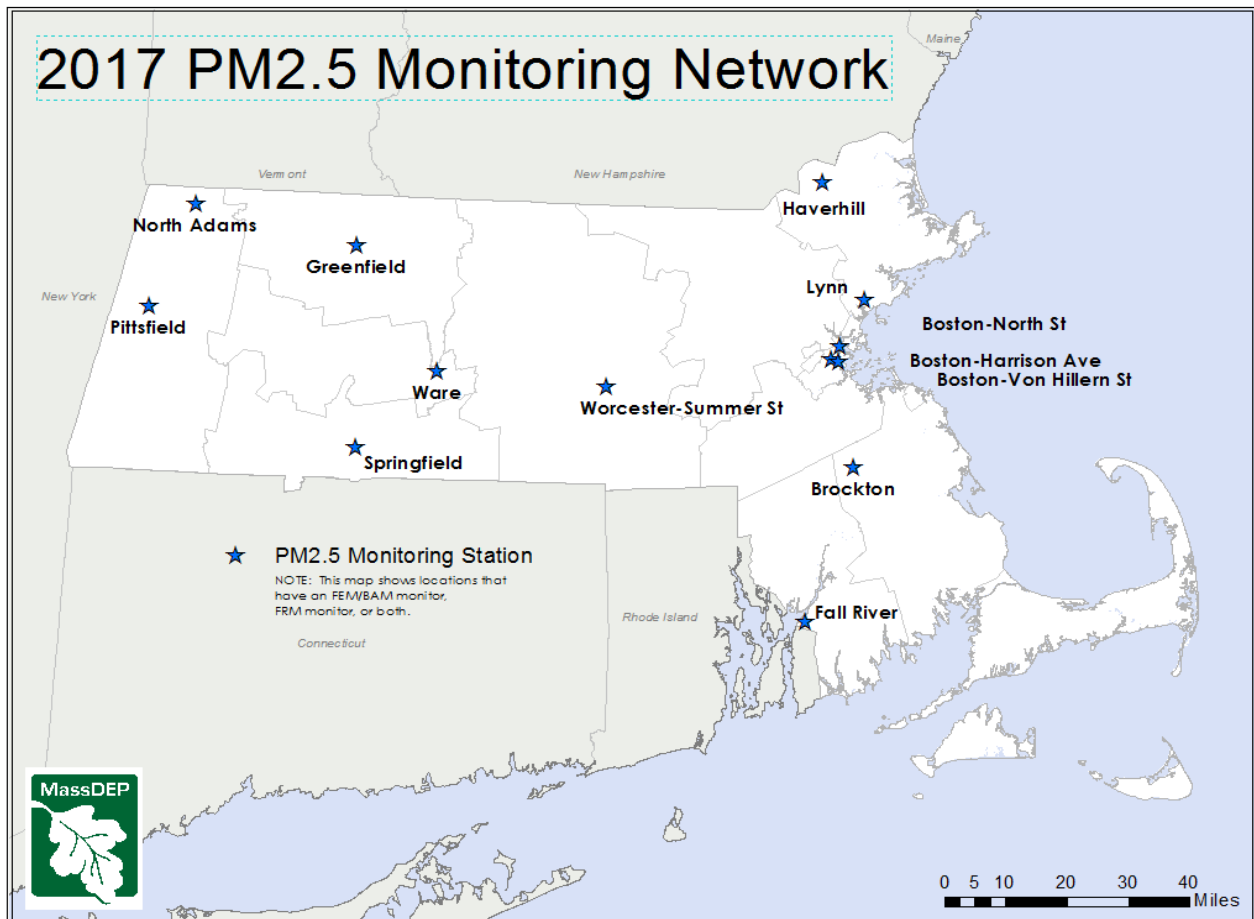
| PM2.5 FRM 2017 | | | | | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | 98TH PERCENTILE | ARITH MEAN |
|----------------|--------|-------------|-----------|-----------------|------------|------------|------------|------------|--------------------|---------------|
| SITE ID | | CITY | COUNTY | ADDRESS | 24-HR | 24-HR | 24-HR | 24-HR | 24-HOUR | |
| 25-025-0002 | | Boston | Suffolk | KENMORE | 13.6 | 13.1 | 12.2 | 11.9 | 12.2 | 6.05 |
| 25-025-0042 | | Boston | Suffolk | HARRISON AVE | 12.3 | 12.2 | 12.1 | 11.4 | 12.1 | 5.33 |
| 25-025-0043 | | Boston | Suffolk | 174 NORTH ST | 23.4 | 15.3 | 15.0 | 14.9 | 14.1 | 7.21 |
| 25-025-0043 | colloc | Boston | Suffolk | 174 NORTH ST | 24.3 | 21.7 | 16.0 | 15.7 | 14.6 | 7.19 |
| 25-025-0044 | | Boston | Suffolk | 19 VON HILLERN | 15.3 | 12.7 | 12.1 | 11.8 | 12.1 | 6.37 |
| 25-023-0005 | | Brockton | Plymouth | 170 CLINTON | 16.3 | 14.9 | 13.4 | 12.7 | 13.4 | 5.67 |
| 25-023-0005 | colloc | Brockton | Plymouth | 170 CLINTON | 15.0 | 11.8 | 11.4 | 11.3 | 11.41 | 5.32 |
| 25-013-0008 | | Chicopee | Hampden | ANDERSON RD AFB | 15.2 | 11.5 | 11.3 | 11.2 | 11.3 | 5.04 |
| 25-013-0008 | colloc | Chicopee | Hampden | ANDERSON RD AFB | 18.9 | 12.6 | 12.5 | 10.7 | 12.5 | 5.05 |
| 25-005-1004 | | Fall River | Bristol | 659 GLOBE ST | 14.0 | 12.6 | 12.3 | 12.1 | 12.3 | 5.11 |
| 25-011-2005 | | Greenfield | Franklin | VETERANS FIELD | 14.7 | 13.4 | 12.7 | 12.6 | 12.7 | 5.89 |
| 25-009-5005 | | Haverhill | Essex | 685 WASHINGTON | 13.6 | 12.3 | 12.0 | 11.8 | 12.0 | 5.14 |
| 25-009-2006 | | Lynn | Essex | 390 PARKLAND | 22.5 | 12.7 | 12.7 | 11.1 | 12.7 | 4.90 |
| 25-003-5001 | | Pittsfield | Berkshire | 78 CENTER ST | 15.2 | 14.3 | 14.1 | 13.3 | 14.3 | 5.77 |
| 25-013-0016 | | Springfield | Hampden | LIBERTY STREET | 14.7 | 14.7 | 14.5 | 13.5 | 14.5 | 6.08 |
| 25-027-0023 | | Worcester | Worcester | SUMMER ST | 24.2 | 14.8 | 13.7 | 12.4 | 13.7 | 5.85 |

STANDARDS: Annual Mean = 12.0 µg/m³ (primary) 24-hour (98th percentile) = 35 µg/m³

ABBREVIATIONS AND SYMBOLS USED IN TABLE

SITE ID = AIRS SITE IDENTIFICATION; **COLLOC** = COLLOCATED; **1ST, 2ND, 3RD, 4TH 24-HR MAX** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR; **98TH PERCENTILE 24-HR** = 98TH PERCENTILE VALUE FOR THE YEAR; **ARITH MEAN** = ANNUAL ARITHMETIC MEAN

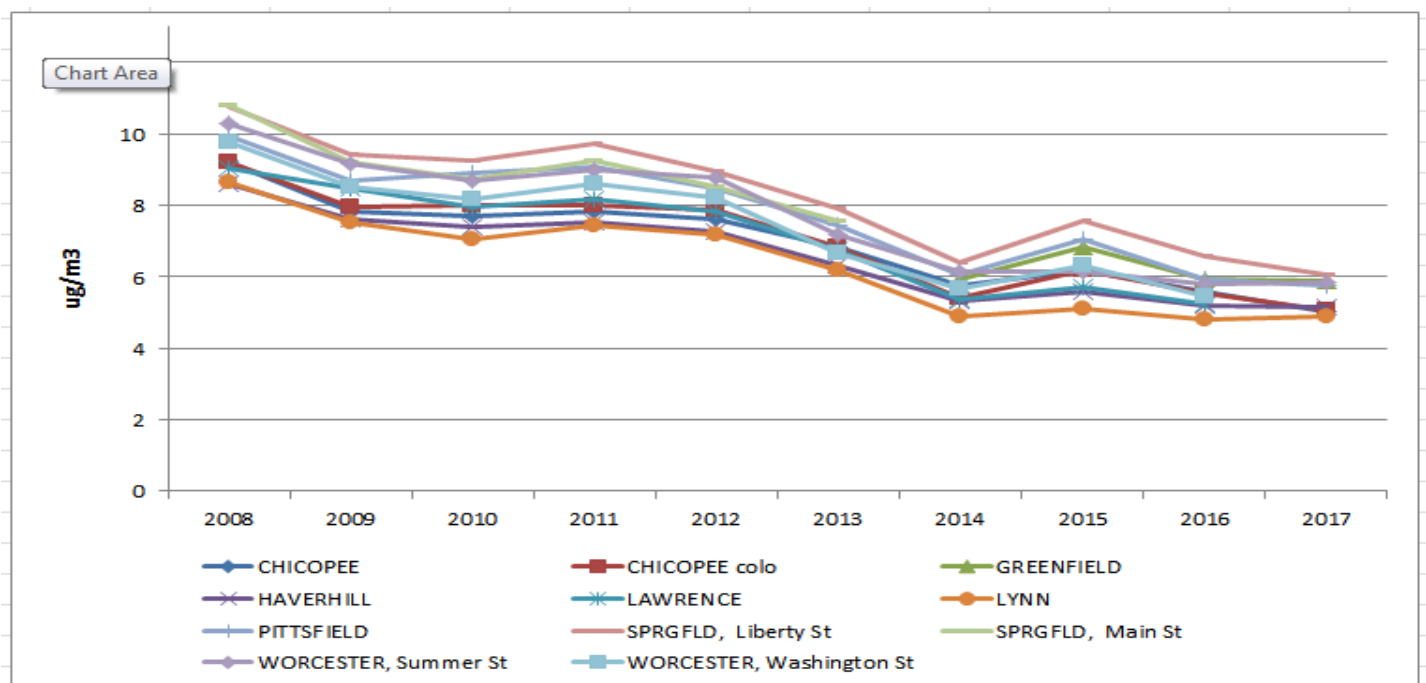
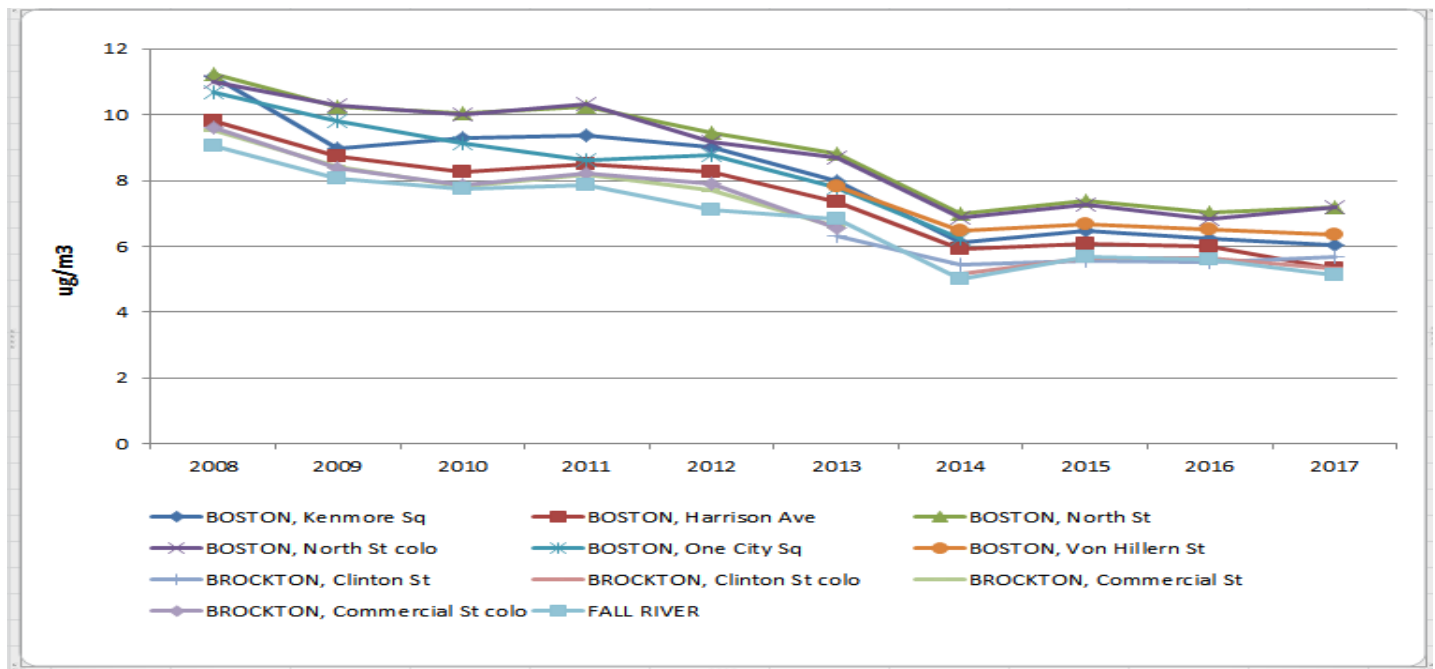
2017 PM2.5 Monitoring Network



PM_{2.5} FRM Trends

Figure 7 shows trends of the annual arithmetic mean for each PM_{2.5} FRM site over the past 10 years. The current annual primary standard is 12 µg/m³.

Figure 7
PM_{2.5} Trends 2008-2017
FRM Annual Arithmetic Mean



2017 PM_{2.5} FEM Data Summary

A summary of the 2017 PM_{2.5} FEM data is shown below (in µg/m³).

| PM 2.5 FEM BAM 2017 | | | | | 1ST | 2ND | 3RD | 4TH | 98TH | |
|---------------------|--------|-------------|-----------|----------------|------|------|------|------|-----------------------|---------------|
| SITE ID | | CITY | COUNTY | ADDRESS | MAX | MAX | MAX | MAX | PERCENTILE 24-HOUR | ARITH MEAN |
| 25-025-0042 | | Boston | Suffolk | HARRISON AVE | 30.0 | 18.0 | 17.9 | 17.4 | 16.4 | 7.61 |
| 25-025-0043 | | Boston | Suffolk | 174 NORTH ST | 22.2 | 18.1 | 17.7 | 17.5 | 16.6 | 8.79 |
| 24-025-0044 | | Boston | Suffolk | VON HILLERN ST | 21.3 | 19.2 | 18.7 | 18.5 | 17.0 | 7.78 |
| 24-025-0044 | colloc | Boston | Suffolk | VON HILLERN ST | 26.1 | 24.2 | 24.2 | 24.1 | 25.0 | 10.79 |
| 25-023-0005 | | Brockton | Plymouth | 1 CLINTON ST | 17.6 | 17.5 | 17.3 | 17.2 | 15.5 | 4.51 |
| 25-005-1004 | | Fall River | Bristol | 659 GLOBE ST | 18.7 | 18.0 | 17.4 | 17.3 | 16.5 | 6.80 |
| 25-011-2005 | | Greenfield | Franklin | VETERANS FIELD | 18.0 | 15.1 | 14.7 | 14.5 | 13.8 | 4.78 |
| 25-009-5005 | | Haverhill | Essex | 685 WASHINGTON | 14.9 | 14.8 | 14.7 | 14.2 | 12.7 | 5.25 |
| 25-009-2006 | | Lynn | Essex | 390 PARKLAND | 23.0 | 17.1 | 17.1 | 16.5 | 15.1 | 4.62 |
| 25-003-6001 | | North Adams | Berkshire | 86 Holden ST | 16.8 | 16.7 | 16.0 | 15.1 | 15.1 | 9.13 |
| 25-003-0006 | | Pittsfield | Berkshire | 1 SOUTH ST | 28.9 | 20.9 | 20.2 | 20.0 | 19.0 | 8.09 |
| 25-013-0016 | | Springfield | Hampden | LIBERTY ST | 22.7 | 20.3 | 20.2 | 20.2 | 17.1 | 6.95 |
| 25-015-4002 | | Ware | Hampshire | QUABBIN SUMMIT | 15.1 | 14.8 | 14.5 | 14.3 | 12.6 | 4.50 |
| 25-027-0023 | | Worcester | Worcester | SUMMER ST | 16.2 | 15.5 | 15.4 | 14.7 | 14.2 | 5.10 |

STANDARDS: Annual Mean = 12.0 µg/m³ (primary) 24-hour (98th percentile) = 35 µg/m³

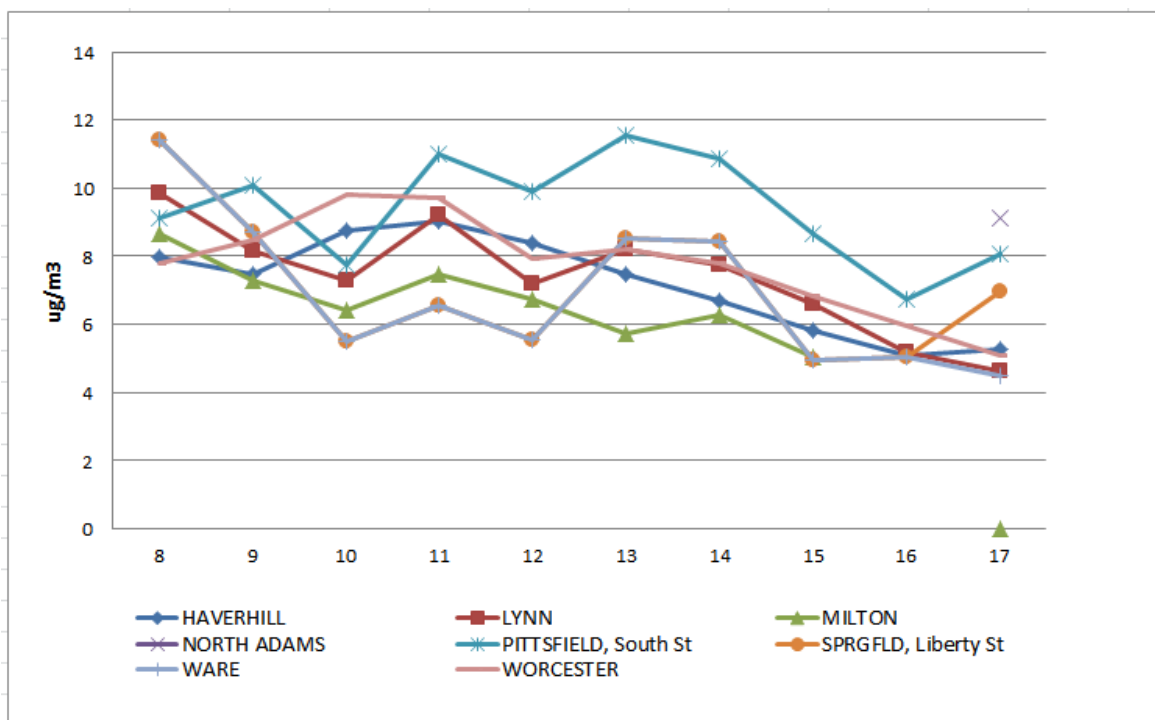
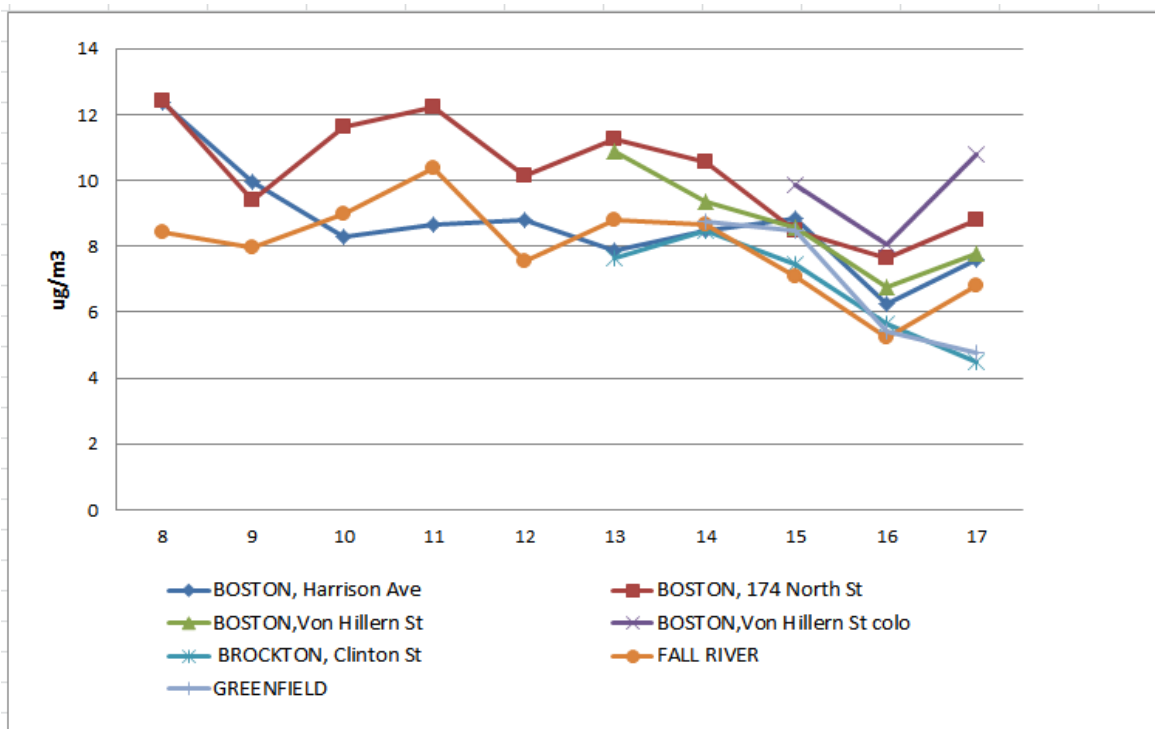
ABBREVIATIONS AND SYMBOLS USED IN TABLE

SITE ID = AIRS SITE IDENTIFICATION; **1ST, 2ND, 3RD, 4TH MAX** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR;
98TH PERCENTILE 24-HR = 98TH PERCENTILE VALUE FOR THE YEAR; **ARITH MEAN** = ANNUAL ARITHMETIC MEAN

PM_{2.5} FEM Trends

Figure 8 shows trends of the annual arithmetic mean for each PM_{2.5} FEM site over the past 10 years. The current annual primary standard is 12 $\mu\text{g}/\text{m}^3$.

Figure 8
PM_{2.5} Trends 2008-2017
FEM Annual Arithmetic Mean



Speciation

MassDEP collects PM_{2.5} samples for speciation in Boston (Harrison Avenue) and Chicopee. Speciation involves analysis of particulate matter to determine its chemical composition and to identify air pollution sources that affect the area around the monitoring station. Pollutants analyzed include elements (e.g., metals), sulfates, nitrates, and carbon (total and organic).

IMPROVE (Interagency Monitoring of Protected Visual Environments)

IMPROVE is a nationwide program designed to assess air quality at rural locations where air pollution may affect visibility over long distances (e.g., mountain ranges or scenic vistas). During 2017, the National Park Service operated an IMPROVE sampler at the Truro monitoring site, and the Wampanoag Tribe operated an IMPROVE sampler at its Martha's Vineyard monitoring site. These samplers acquire PM_{2.5} filter samples for speciation analysis to determine effects on visibility. Data can be viewed at the IMPROVE web site at <http://vista.cira.colostate.edu/improve/Data/data.htm>.

QUALITY CONTROL AND QUALITY ASSURANCE

In order to ensure that all air quality data is of acceptable and consistent quality, MassDEP has developed standard operating procedures (SOPs) based on federal requirements that include quality control and quality assurance protocols that systematically assess the entire sample collection and data handling system on an ongoing basis. Ambient air monitoring quality assurance requirements are contained in the Federal Regulations at 40 CFR Part 58, Appendix A – E. Each year MassDEP certifies that it is in compliance with the federal requirements. A few of the considerations that affect sample collection data quality are:

- Site Placement
- Intake Probe Material
- Intake Probe Height
- Spacing from roadways and trees

For data processing there are quantitative statistics and qualitative descriptors used to interpret the degree of acceptability and utility of data. Examples of these data quality indicators are:

- Representativeness
- Precision
- Bias
- Detectability
- Completeness
- Comparability

MassDEP's Air Assessment Branch maintains a Quality Assurance Group that ensures that samples are collected correctly and conducts performance audits throughout the air monitoring network to verify data validity. There also is a Quality Control Group that reviews daily monitored data for validity, tracks precision results, finalizes monthly values, and submits air quality data to EPA's database in a timely manner. Computer software tools, report queries, and "eyes on" data reviews all are used to validate data before it is submitted to EPA. EPA also conducts its own performance audits on MassDEP samplers and every three years conducts thorough Technical Systems Audit (TSA). The latest TSA was conducted in 2016.

Section IV

PAMS/Air Toxics Monitoring

PAMS Monitoring

Ground-level ozone is a secondary pollutant and is not discharged directly to the atmosphere from a stack or tailpipe, but forms in the atmosphere from the photochemical reactions of other pollutants such as VOCs and NO_x. Ozone formation can occur many miles downwind from the source of the original emissions. These reactions occur in the presence of strong sunlight and are most pronounced during the hottest days of the summer. The PAMS (Photochemical Assessment Monitoring Stations) program was established by the 1990 Clean Air Act Amendments as a way to collect data for assessing NAAQS attainment progress independent of the meteorological variation that occurs between years and for identifying appropriate pollution control strategies. MassDEP currently operates PAMS stations in Lynn and Chicopee.

PAMS is a special designation for enhanced monitoring stations that are designed to gather information on the ozone formation process. Instruments at these sites measure pollutants and meteorological parameters that are specific to the photochemical processes by which ozone is created in the atmosphere at ground level. In addition to the pertinent NAAQS pollutants (ozone, NO₂, etc.), non-criteria pollutants, including VOCs, are measured at PAMS stations on either an hourly basis or at regular intervals during the hottest part of the summer in June, July and August. Meteorology is a critical component of ozone formation and each PAMS site has a full complement of meteorological sensors including wind speed, wind direction, temperature, relative humidity, barometric pressure, solar radiation and at some sites, total ultraviolet light and precipitation.

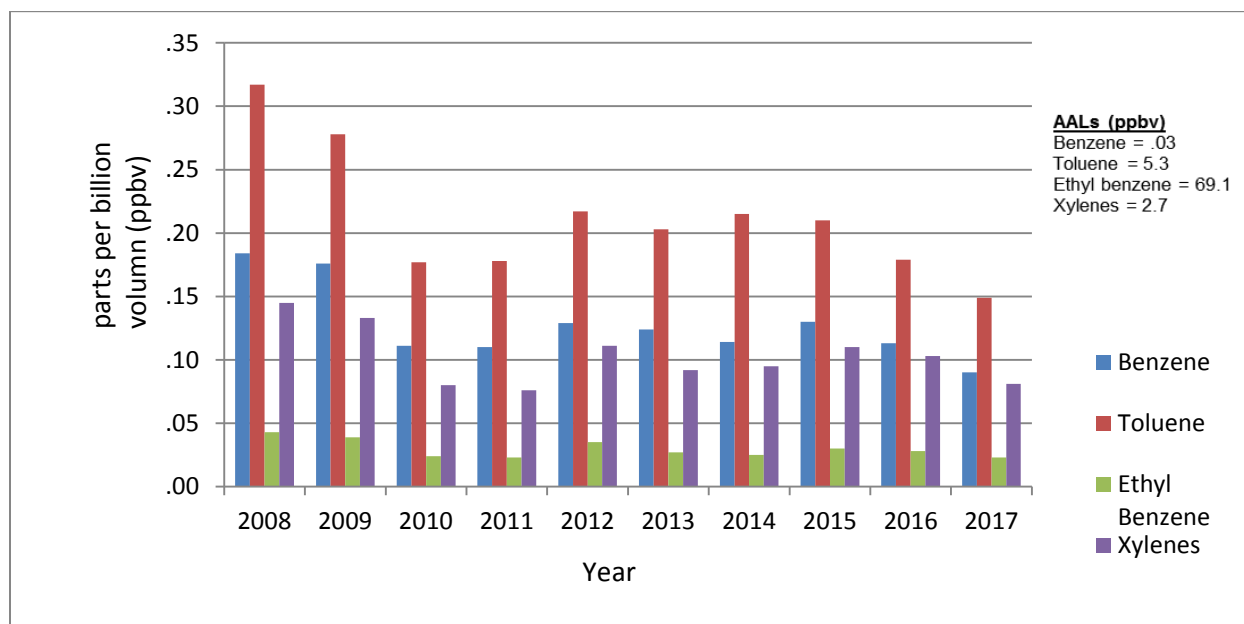
Air Toxics Monitoring

Toxic air pollutants are known or suspected to cause cancer or other serious health effects. Air toxics include certain volatile organic compounds (VOCs) and toxic metals (e.g., arsenic, cadmium).

The Boston (Harrison Avenue) monitoring site is designated as a National Air Toxics Trends Station (NATTS) designed to collect and quantify a number of toxic air pollutants, including VOCs, metals, carbonyls, black carbon and polycyclic aromatic hydrocarbons (PAHs). Data from this site is compared with data from a network of similar sites across the country to identify transport, trends and site-specific characteristics of these pollutants.

MassDEP also monitors VOCs as part of the PAMS monitoring program, some of which are classified as air toxics. Figure 9 summarizes concentrations health-relevant VOCs measured at the Lynn PAMS site for the past 10 years. Allowable Ambient Limit (AAL) values are presented for reference. AALs are health-based air toxics guidelines developed by MassDEP based on known or suspected carcinogenic and toxic health properties of individual compounds. AAL concentrations were developed for a 70-year lifetime exposure, but are used for comparison with annual averages.

Figure 9
Lynn Toxics VOC Summary 2008– 2017
24-hour samples



The table below summarizes 24-hour concentrations of target VOCs measured at the Boston (Harrison Ave) and Lynn sites for 2017. Harrison Avenue serves as the central city sampling location and Lynn serves as the area background site.

| 2017 Compound | BOSTON (Harrison Ave) | | Lynn | |
|-----------------------|-----------------------|-------------|------------------|-------------|
| | Max Value ppb | Mean ppb | Max Value ppb | Mean ppb |
| 1,3-butadiene | 0.038 | 0.015 | 0.030 | 0.009 |
| 1,1,1-trichloroethane | 0.000 | 0.000 | 0.000 | 0.000 |
| trichloroethylene | 0.000 | 0.000 | 0.000 | 0.000 |
| tetrachloroethylene | 0.050 | 0.000 | 0.050 | 0.005 |
| Benzene | 0.233 | 0.117 | 0.250 | 0.090 |
| Toluene | 0.871 | 0.210 | 0.514 | 0.149 |
| Xylenes | 0.288 | 0.125 | 0.238 | 0.081 |
| Ethylbenzene | 0.063 | 0.031 | 0.063 | 0.023 |

Samples collected at the Harrison Avenue site are analyzed for a suite of metals that are known to be toxic in the environment. The table below summarizes the 2017 metals data.

| BOSTON (Harrison Ave) | | | |
|-----------------------|--------------|--------------------|------------|
| 2017 | | | |
| METAL | # of Samples | Max Value ug/m3 | Mean ug/m3 |
| Antimony | 55 | .00489 | .00150 |
| Arsenic | 55 | .00189 | .00042 |
| Beryllium | 55 | .00002 | .00001 |
| Cadmium | 55 | .00017 | .00007 |
| Chromium | 55 | .00635 | .00442 |
| Cobalt | 55 | .00020 | .00008 |
| Lead | 28 | .00000 | .00000 |
| Manganese | 55 | .00926 | .00425 |
| Mercury | 55 | .00009 | .00001 |
| Nickel | 55 | .03640 | .00159 |
| Selenium | 55 | .00064 | .00022 |

Appendix A

2017 Monitoring Station Locations

| SITE ID | CITY | COUNTY | ADDRESS | PARAMETERS MONITORED |
|-------------|-------------|------------|--------------------|---|
| 25-007-0001 | AQUINNAH* | DUKES | HERRING CREEK RD | O3, IMPROVE |
| 25-025-0002 | BOSTON | SUFFOLK | KENMORE SQUARE | NO, NO2, NOx, SO2, PM2.5 |
| 25-025-0042 | BOSTON | SUFFOLK | HARRISON AVENUE | O3, NO, NO2, NOx, NOy, SO2, CO, PM2.5, PM10, PM Coarse, PM2.5 Speciation, Toxics, Carbonyls, Black Carbon, WS/WD, WSv/WDv, TEMP, SUN, REL, BP |
| 25-025-0043 | BOSTON | SUFFOLK | 174 NORTH ST | PM2.5, Black Carbon |
| 25-025-0044 | BOSTON | SUFFOLK | VON HILLERN ST | NO, NO2, NOx, CO, PM2.5, Black Carbon, WS/WD, TEMP, SUN, REL, BP |
| 25-023-0005 | BROCKTON | PLYMOUTH | 170 CLINTON ST | O3, PM2.5 |
| 25-017-0009 | CHELMSFORD | MIDDLESEX | 11 TECHNOLOGY DR | O3 |
| 25-013-0008 | CHICOPEE | HAMPDEN | ANDERSON RD | O3, NO, NO2, NOx, CO, PM2.5, PM2.5 speciation, VOCs, Carbonyls, WS/WD, TEMP, SUN, REL, BP |
| 25-005-1006 | FAIRHAVEN | BRISTOL | HASTINGS SCHOOL | O3, WS/WD, TEMP, SUN, REL, BP |
| 25-005-1004 | FALL RIVER | BRISTOL | GLOBE ST | O3, SO2, PM2.5 |
| 25-011-2005 | GREENFIELD | FRANKLIN | 16 BARR AVE | O3, PM2.5, Black Carbon, WS/WD, TEMP, SUN, REL, BP |
| 25-009-5005 | HAVERHILL | ESSEX | WASHINGTON ST | O3, PM2.5, WS/WD, TEMP, SUN, REL, BP |
| 25-009-2006 | LYNN | ESSEX | 390 PARKLAND | O3, NO, NO2, NOx, CO, PM2.5, VOCs, Toxics, Carbonyls, WS/WD, TEMP, SUN, REL, BP, PRECIP |
| 25-021-3003 | MILTON | NORFOLK | BLUE HILL | O3, NO, NO2, NOx, VOCs, WS/WD, TEMP, SUN, REL, BP |
| 25-009-4005 | NEWBURYPORT | ESSEX | HARBOR STREET | O3, NO, NO2, NOx, NOy, VOCs, WS/WD, TEMP, SUN, REL, BP |
| 25-003-6001 | NORTH ADAMS | BERKSHIRE | 86 HOLDEN STREET | PM2.5, Black Carbon |
| 25-003-5001 | PITTSFIELD | BERKSHIRE | 78 CENTER STREET | PM2.5 |
| 25-003-0006 | PITTSFIELD | BERKSHIRE | BERKSHIRE COMMONS | PM2.5 |
| 25-013-0016 | SPRINGFIELD | HAMPDEN | LIBERTY STREET | NO, NO2, NOx, SO2, CO, PM2.5, PM10, Black Carbon, Lead |
| 25-001-0002 | TRURO | BARNSTABLE | FOX BOTTOM AREA | O3, WS/WD, TEMP, SUN, REL, BP, IMPROVE |
| 25-027-0024 | UXBRIDGE | WORCESTER | 366 E HARTFORD AVE | O3, WS/WD, TEMP, SUN, REL, BP |
| 25-015-4002 | WARE | HAMPSHIRE | QUABBIN SUMMIT | O3, NO, NO2, NOx, NOy, SO2, PM10, VOCs, PM2.5, WS/WD, TEMP, SUN, REL, BP, PRECIP |
| 25-027-0015 | WORCESTER | WORCESTER | WORC. AIRPORT | O3, WS/WD, TEMP, SUN, REL, BP |
| 25-027-0023 | WORCESTER | WORCESTER | SUMMER STREET | NO, NO2, NOx, SO2, CO, PM2.5, PM10 |

* Wampanoag Tribal Site